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ROENTGEN RAY STUDY OF THE ABDOMINAL ORGANS FOLLOWING OXYGEN INFLATION OF THE PERITONEAL CAVITY *†

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MOST of us are familiar with the fact that roentgen ray examination of the body cavities after the introduction of air or gas intensifies the shadows of soft parts, bringing out details that cannot be obtained by any other method. This procedure has been repeatedly employed as a diagnostic aid in the examination of the urinary bladder, of the renal pelvices and of the knee joint. In 1914 Dr. W. H. Stewart and Dr. W. L. Luckett of New York demonstrated roentgenographically the ventricles of the brain in a case of fracture of the skull where air had invaded the interior. This experience has since been used practically by Dr. W. E. Dandy of Baltimore, who describes a method of outlining roentgenographically the cerebral ventricles by injecting air into the cavities of the brain. He has found this technique of great value in the diagnosis of hydrocephalus and other intracranial conditions.

Credit for the original idea of air inflation of the peritoneal cavity in conjunction with roentgen ray examinations must be given to Kelling, who employed it in 1902 in two human beings, one a case of ascites, the other a carcinoma of the stomach.

Eight years later in 1910 and 1911 Jacobaeus of Stockholm revived the method and emphasized the safety of the abdominal puncture on a basis of over twenty experiments on cadavers, in which a trocar was pushed through the abdominal wall and invariably reached the peritoneal cavity without damaging the viscera. Excellent results were obtained by him in seventeen cases of abdominal conditions, including the diagnosis of a metastatic nodule in the liver, gastric cancer, and general carcinosis of the intestine. A monograph on the subject of laparo- and thoracoscopy under air inflation was published by him in 1913, wherein conditions are described as relatively favorable in the living subject, because of the yielding and elastic character of the intestinal walls.

In January, 1912, Weber, working in the

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Private Institute for Roentgen Diagnosis of Drs. Eugene Weber and V. von Bergman of Kies, conceived the idea, based on the roentgen examination of a bladder filled with oxygen showing good detail of a hypertrophied prostate, that the introduction of sterile inactive oxygen or air into the abdominal cavity might help to render visible a number of organs, tumors, and abdominal areas which heretofore had been more or less inaccessible to the roentgen ray examination. Experiments on animals and fresh cadavers of children confirmed this theory. His roentgenograms showed that the following viscera and areas may be rendered visible by means of gas inflation of the abdomen: The liver and spleen as a whole, including the region of the gall bladder; coils of the large and small intestines without bismuth filling; the pyloric end of the stomach; the wall of the stomach and large intestines with gas contents; the bladder filled with urine; parts of the mesentery; the subphrenic space, not readily accessible to diagnosis, and many abdominal tumors. He emphasized the far-reaching importance of air or oxygen inflation of the abdominal cavity for experimental and diagnostic roentgenology, and laid stress on the value of the method for obtaining good roentgenograms of the liver and biliary region, as well as for the roentgenographic representations of tumors and inflammatory swellings.

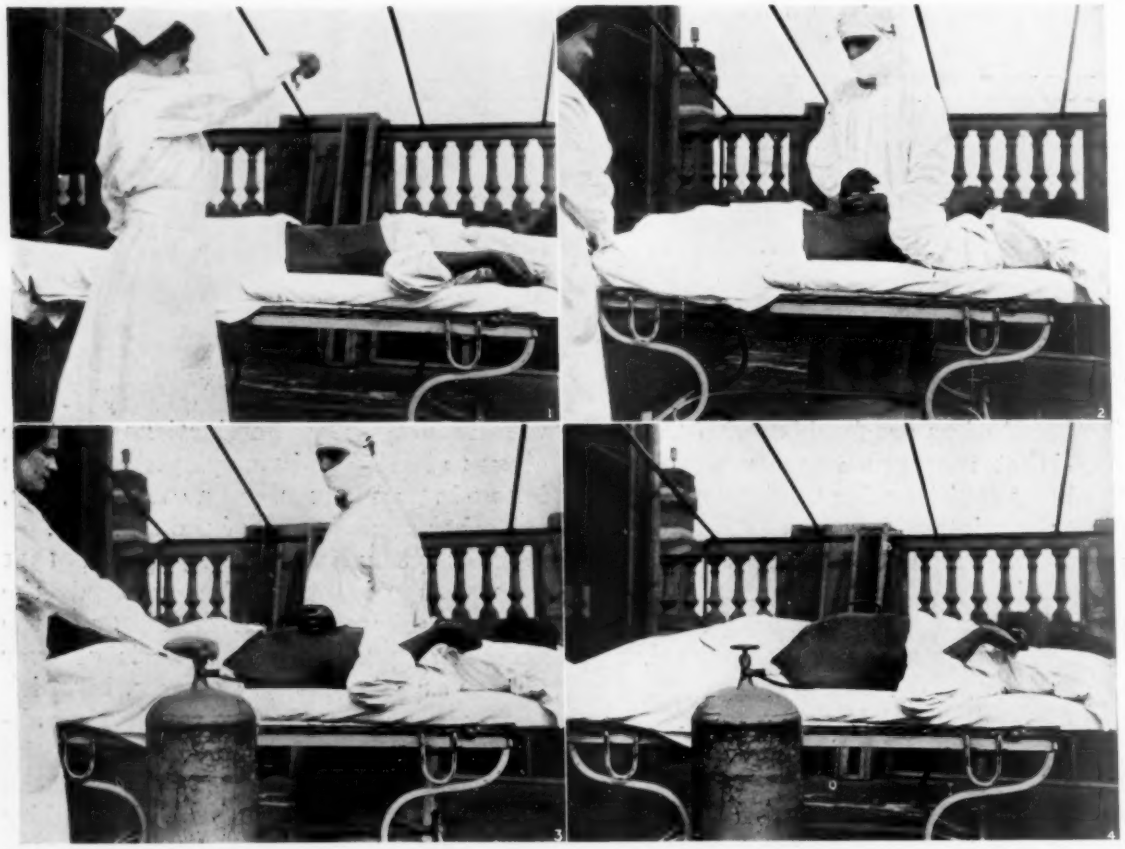


FIG. 1. READY FOR THE PUNCTURE. Freezing of the spot with ethyl chlorid. FIG. 2. NEEDLE INSERTED AND THE PLUG BEING WITHDRAWN. FIG. 3. NEEDLE CONNECTED WITH THE TUBE AND OXYGEN BEING INFLATED. The nurse is seen slowly opening the oxygen tank. FIG. 4. INFLATION COMPLETED. Note the difference in the distention of abdomen between this plate and No. 1.

During the same year, Lorey in con-

nection with the demonstration of a peculiar case of ascites pointed out that after the introduction of air or nitrogen into the abdominal cavity, it was possible to demonstrate the contour of the spleen

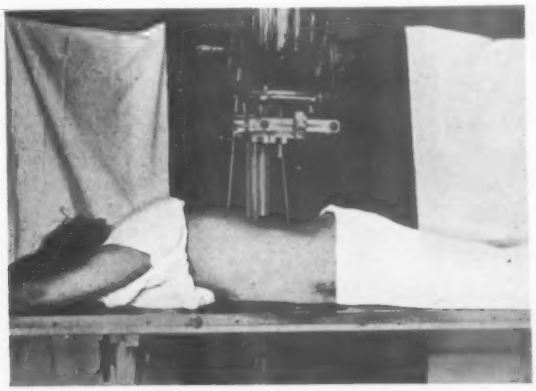


FIG. 5. POSITION NO. 1. Position of the patient and apparatus to obtain best detail of the diaphragm, liver, gallbladder and spleen.

logical changes. The method was employed by him after abdominal paracentesis in a case of hepatic cirrhosis with good results.

Systematic experiments for the purpose of rendering the liver accessible to roentgenology were carried out in 1914 by Rautenberg, who introduced air by puncture into the abdominal cavity in diseases of the liver, complicated by ascites. He recommended the method as affording remarkable information concerning the organs situated below the diaphragm. Conditions such as carcinoma of the liver, sarcoma of the spleen, etc., were recognized by this procedure. He contributes four interesting illustrations of lesions of this character.

Meyer-Betz in a communication during 1914 discussed the clinical importance of roentgenographic representation of the

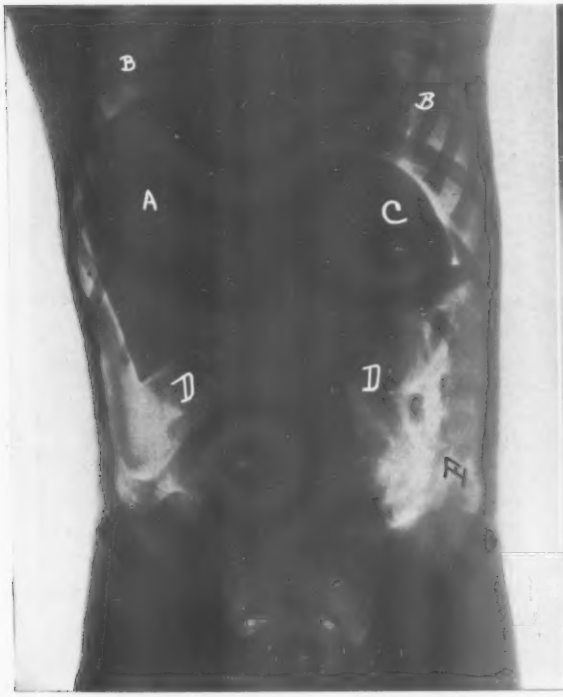


FIG. 6. OBTAINED WITH PATIENT IN POSITION NO. 1. *A*. Liver; *B*. Diaphragms; *C*. Spleen; *D*. Coils of small intestines; *E*. Descending colon.

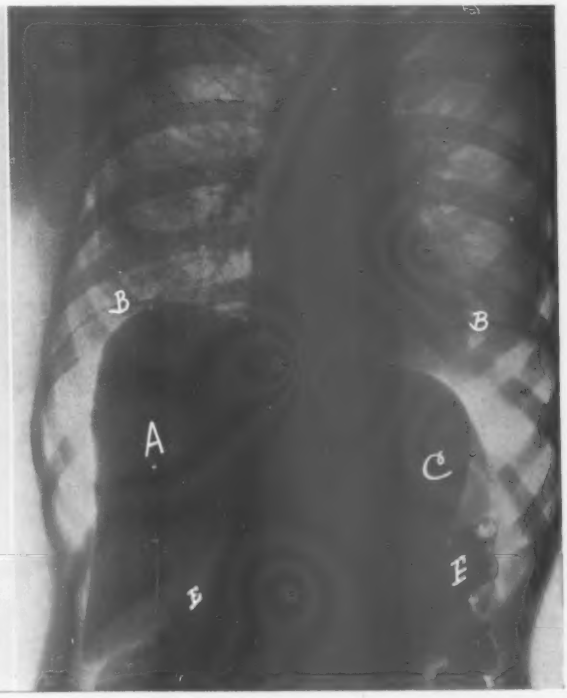


FIG. 7. OBTAINED WITH PATIENT IN POSITION NO. 1. *A*. Liver; *B*. Diaphragms; *C*. Spleen; *D*. Gallbladder; *E*. Barium-filled splenic flexure.

and liver with great detail, and to recognize the presence of tumors projecting above the surface as well as other patholiver by means of air or oxygen inflation of the peritoneal cavity. He called attention to the fact that correctly employed

this procedure affords valuable assistance in the early diagnosis of abdominal tumors and their relation to the other organs in the abdominal cavity.

In November, 1918, Goetze, in apparent ignorance of the former work on this subject with the exception of Rautenberg, reported very remarkable roentgenographic results concerning nearly all of the abdominal organs, obtained by filling the peritoneal cavity with oxygen before making the roentgen examination.

diaphragm into the liver. Fluoroscopically the projectile was seen to rise and fall with the apparently normal diaphragmatic excursions. There were no evidences of pleural adhesions. Surgical procedure by Dr. Willy Meyer revealed the bullet lying in the liver just beneath the perforated diaphragm. This case was presented before the New York Thoracic Society. During the discussion Dr. Howard Lilienthal of New York suggested that the lung could have been excluded by producing

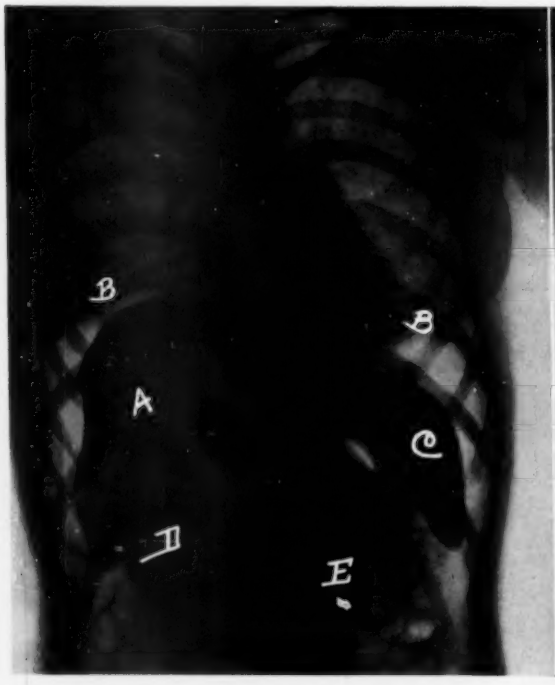


FIG. 8. OBTAINED WITH PATIENT IN POSITION NO. 1. *A*. Liver; *B*. Diaphragms; *C*. Spleen and pedicle; *D*. Right kidney; *E*. Left kidney.

FIG. 9. OBTAINED WITH PATIENT IN POSITION NO. 1. *A*. Liver; *B*. Diaphragms; *C*. Left lobe liver; *D*. Spleen and pedicle; *E*. Enlarged mesenteric glands.

The latest contribution to this subject is made by A. Schmidt who, in February, 1919, published an article confirming the opinion of former authors as to the value of this method.

The occasion which particularly called our attention to this work was a case of gun shot wound of the chest. In attempting to localize the bullet we had difficulty in ascertaining whether it was located in the lower lobe of the lung, embedded in the diaphragm, or had passed through the

an artificial pneumothorax, the bullet, if in the lower portion of the lung, would have receded from the diaphragm with the pulmonary collapse. If this could be done, we saw no reason why the presence of the bullet in the liver could not be determined by producing a pneumoperitoneum, feeling confident that air or oxygen would separate the diaphragm from the liver. After reviewing the literature on the subject we determined to try the method, using oxygen as suggested.

We have examined altogether 37 cases, the results of which investigations have been somewhat startling. Not only did we find the diaphragm completely separated from the liver and obtain a detail of the liver that had never before seemed possible, but in addition we succeeded in accurately outlining the spleen with its pedicle, both kidneys, and under special technique we obtained shadows of the uterine appendages. In one case we

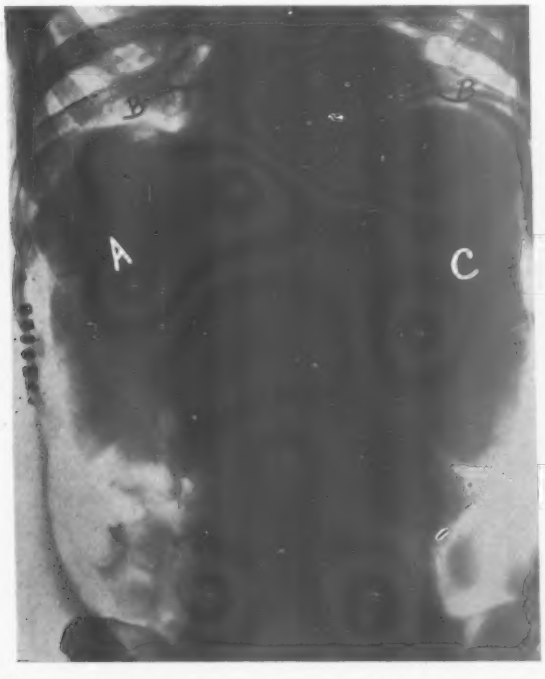


FIG. 10. OBTAINED WITH PATIENT IN POSITION NO. 1. *A*. Enlarged syphilitic liver; *B*. Diaphragms; *C*. Enlarged syphilitic spleen.

were able to detect a chain of enlarged mesenteric glands. Intraperitoneal adhesions, especially involving the anterior abdominal wall, were easily shown. It was thus demonstrated that this method opened up an entirely new field for investigation, particularly of the parenchymatous abdominal organs.

The technique required for the inflation is extremely simple. After the intestinal tract has been thoroughly cleansed and the bladder emptied, the patient is put upon his back. As a rule a point is selected on the anterior abdominal wall about 1 inch to the right or left and 2 inches below the umbilicus. The skin is thoroughly scrubbed and sterilized with tincture of iodine. If adhesions are known to be present or an abdominal scar is visible, it is well to avoid this area. After the skin has been anesthetized with an ethyl cloride spray, an ordinary lumbar puncture needle is passed obliquely downward until it reaches the fascia; the needle is then pushed gently through the fascia muscle and peritoneum into the abdominal cavity. The plug is withdrawn and the needle connected with a rubber tube,

FIG. 11. POSITION NO. 2. POSITION OF THE PATIENT AND APPARATUS TO OBTAIN BEST DETAIL OF KIDNEY. Patient lying on left side for right kidney and lateral liver; on right side for left kidney and lateral spleen.

the other end of this tube having been previously attached to the outlet of an ordinary oxygen tank. Oxygen is now allowed to flow gently into the peritoneal cavity. Sufficient gas should be used to render the abdomen dome-shaped in appearance; as a rule it requires about four liters, the quantity depending largely on the amount of relaxation to the abdominal walls. In case the pressure from the tank should be too high, the rubber tube will jump off the needle, as the caliber of the needle is very small.

The tube is then disconnected, the needle quickly withdrawn, and the site of

the puncture covered with a small piece of adhesive plaster, the entire procedure having been conducted under modern aseptic precautions.

The patient frequently complains of a sense of fullness from the distention, and may have some pain in the shoulders, especially the right, probably caused by pressure on the diaphragm. This pain varies in intensity, usually gradually disappearing within a few hours. Only three cases in our series have required an opiate.

The roentgen examination should be made as soon as possible after the inflation. It is well, however, to allow the patient to become accustomed to the distention before proceeding. As a rule about an hour is sufficient. If a longer interval is allowed emphysema is liable to occur from leakage of oxygen through the peritoneal opening into the outlying structures. Such an event interferes with obtaining clear detail of the abdominal organs.

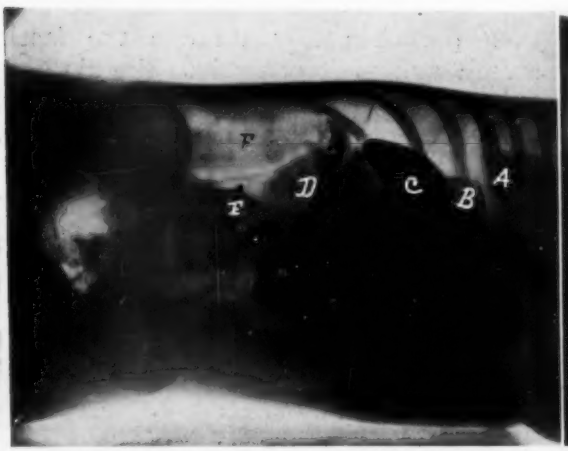


FIG. 12. OBTAINED WITH PATIENT IN POSITION NO. 2. *A*. Left diaphragm; *B*. Left lobe liver; *C*. Spleen; *D*. Left kidney; *E*. Inferior mesenteric artery; *F*. Descending colon.

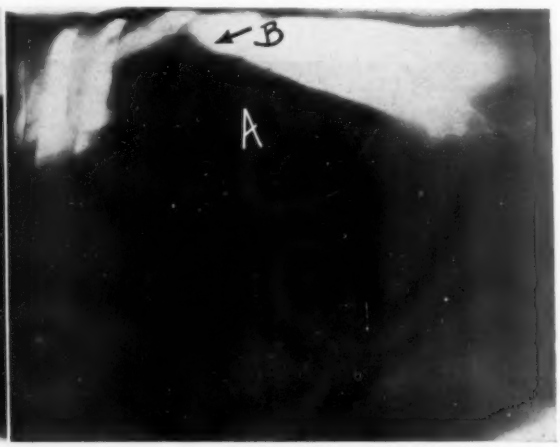


FIG. 14. OBTAINED WITH PATIENT IN POSITION NO. 2. *A*. Liver; *B*. Gumma of liver.

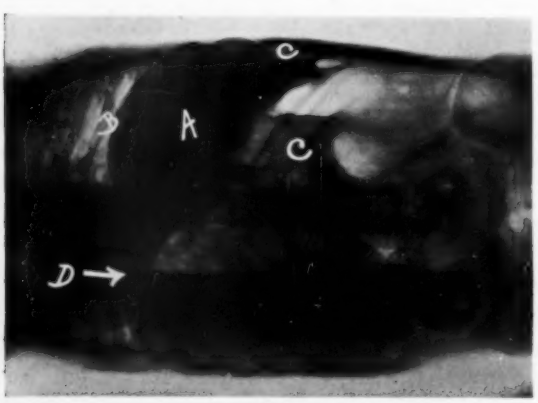


FIG. 13. OBTAINED WITH THE PATIENT IN POSITION NO. 2. TUBERCULAR PERITONITIS. *A*. Liver; *B*. Right diaphragm; *C*. Adhesions; *D*. Fluid level—Ascites.

Up to the present time we have not attempted sterilizing, filtrating or washing the oxygen, feeling that the more complicated the apparatus the more liable we are to infection.

The oxygen is gradually absorbed by the abdominal tissues, disappearing almost completely in from 24 to 48 hours.

The roentgen technique is not complicated. Satisfactory fluoroscopic observations can be made in the prone; more reliance is placed on the roentgenographic studies, however, as the patient must be placed in positions which are difficult to duplicate under the screen. The cardinal point to be constantly borne in mind in making the roentgenographic examination is that the particular organ which is to be investigated must be placed in the highest plane possible in order that it may be completely surrounded by the gas, and

that the intestines, which are freely movable in the presence of oxygen, be allowed to drop away, thus avoiding conflicting shadows. This particularly applies to the kidneys and uterine appendages.

To obtain the best detail of the diaphragm and liver with the gall-bladder region, the spleen and the glandular enlargements, the patient lies on the abdomen with the tube above, and stereoscopic roentgenograms are made from behind forward.

Further liver and spleen details with excellent kidney outline are obtained by having the patient lie on the side. If the left kidney and spleen are being investigated, the patient lies on the right side, the left being uppermost, the tube is placed in front and the plate properly supported with sand bags behind. If detail of the liver and right kidney are sought, the patient lies on the left side, other requirements being the same.

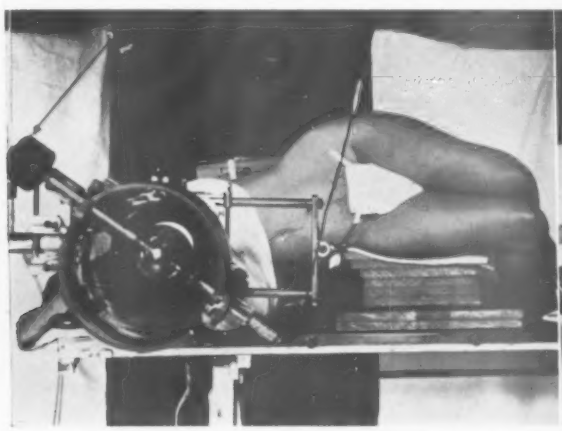


FIG. 15. POSITION NO. 3. Position of the patient and apparatus to obtain detail for lateral pelvis and kidneys.

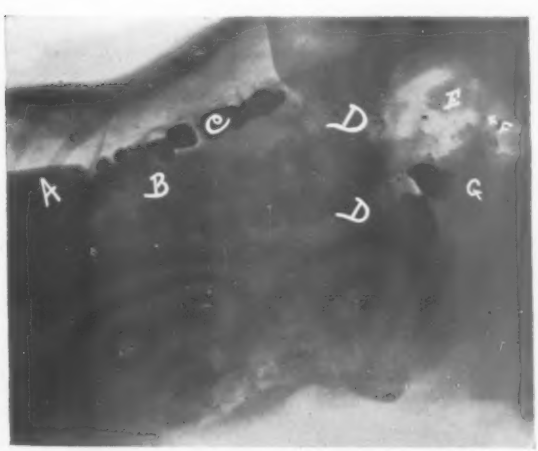


FIG. 16. OBTAINED WITH PATIENT IN POSITION NO. 3. *A*. Spleen; *B*. Left kidney; *C*. Descending colon; *D*. Pelvic colon; *E*. Left ovary; *F*. Left tube; *G*. Fundus uteri.

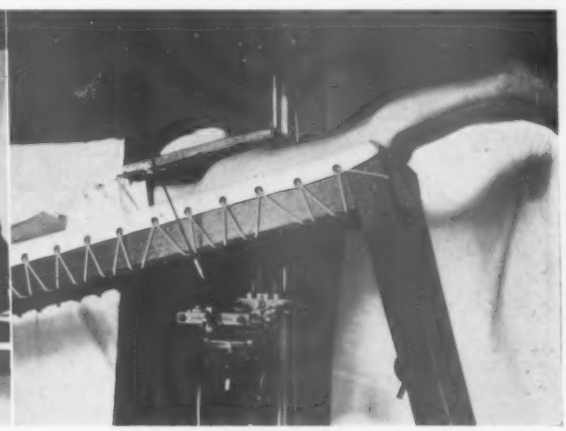


FIG. 17. POSITION NO. 4. Best position of patient and apparatus to obtain detail of the pelvic organs.

There are two positions for obtaining satisfactory shadows of the uterus and appendages: the right and left exaggerated lateral Trendelenburg, obtained by placing the patient on the side and elevating the hips on a support about 6 inches high with the thighs and legs slightly flexed and the shoulders and head low, resting on the table; the tube and plate in similar relation to the patient as in the straight lateral. The other position, which seems to bring out the best detail of the pelvic organs, is obtained by the use of a canvas top table, one end of which has been elevated about 15 degrees. The patient lies on the abdomen, the head towards the most dependent portion of the table, the plate is placed on the back, properly held in position by sand bags, the tube is beneath, the anode being centered on the promontory of the sacrum. By this method the intestines drop out of the pelvis and are

FIG. 18. OBTAINED WITH PATIENT IN POSITION NO. 4. *A*. Fundus uteri; *B*. Right tube; *C*. Right ovary; *D*. Left tube drawn over by adhesions; *E*. Left ovary.

information than those described. The field seems unlimited. Plates in envelopes are used, as giving the best detail.

The two factors that must be considered in the use of this method are the danger of infection and the risk of puncturing the intestines. The first can be overcome by the

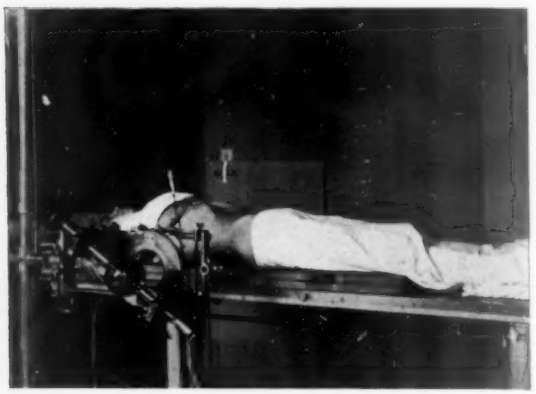


FIG. 19. POSITION NO. 5. Position of patient and apparatus to obtain best detail of intra-abdominal adhesions especially if they involve the anterior abdominal wall.

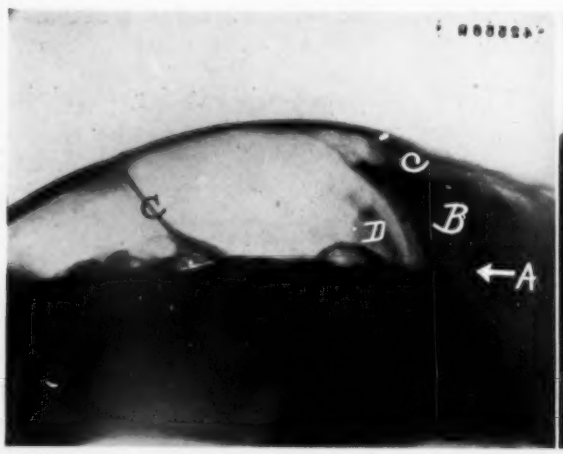


FIG. 20. OBTAINED WITH THE PATIENT IN POSITION NO. 5. TUBERCULAR PERITONITIS. *A*. Fluid level—Ascites; *B*. Liver; *C*. Adhesions; *D*. Right kidney.

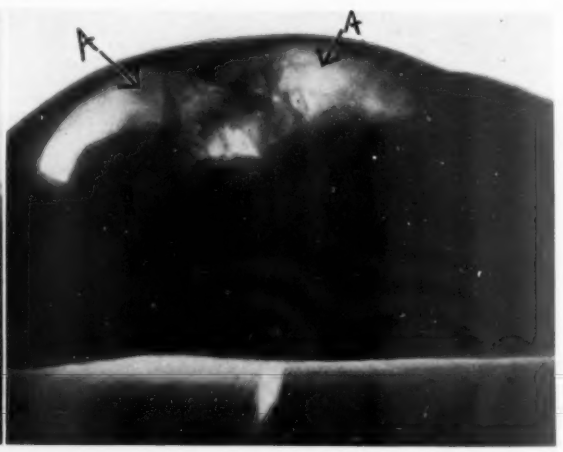


FIG. 21. OBTAINED WITH THE PATIENT IN POSITION NO. 5. TUBERCULAR PERITONITIS. *A*. Adhesions.

replaced by the oxygen, which surrounds the fixed organs.

Intraperitoneal adhesions are detected by placing the patient on the back, the plate on one side and the tube on the other.

No doubt as the work advances other positions will be developed giving more ordinary precautions; regarding the second objection we feel that with care there is absolutely no danger of puncturing the intestine. In our series of 37 cases we have never experienced the least difficulty. It has been demonstrated that with a needle passed through the abdominal

wall into the peritoneal cavity of a live rabbit, the intestines would always recede before the sharp point, and the moment the rabbit died puncture would occur. This characteristic of the involuntary muscle fiber is also practically shown by the large number of sharp foreign bodies which pass through the intestinal tract without puncture. We have never known of a puncture of the intestines occurring in a paracentesis of the peritoneal cavity when ordinary precautions were observed.

In conclusion we should like to state that from our present experience this procedure is not a competitor of the opaque meal method, as the latter concerns the hollow organs, while oxygen inflation of the peritoneal cavity gives us information more particularly as to the solid structures of the abdominal cavity. In conjunction, the results should be ideal.

REFERENCES

DANDY, W. E. "Ventriculography Following the Injection of Air Into the Cerebral Ventricles." *Am. J. Roentgenol.*, vol. vi, No. 1, 1919, p. 26. Also *Ann. Surg.*, July, 1918, vol. lxviii.

GOETZE, C. "Die Roentgendiagnostik bei gasgefüllter Bauchhöhle, eine neue Methode." *München. Med. Wchschrft.*, 1918.

JACOBAEUS, H. C. "Ueber die Möglichkeit die Cystoskopie bei Untersuchung seröser Höhlungen anzuwenden." *München. Med. Wchschrft.*, 1910. No. 40, p. 2090.

IDEM. "Ueber Laparo- und Thorakoskopie." *Monograph, Wurzburg*, 1913.

KELLING, G. "Ueber Oesophagoskopie, Gastroskopie und Coeloskopie." *München. Med. Wchschrft.*, 1902. No. 1, p. 21.

LOREY. "Demonstration einiger seltener Roentgenbefunde." *Verhandl. d. Deutsch. Röntg.-Gesellsch.*, viii, p. 52.

MEYER-BETZ, F. "Methode und klinische Bedeutung der Darstellung der Leber in Roentgenbild." *München. Med. Wchschrft.*, 1914. No. 15, p. 810.

RAUTENBERG, E. "Roentgen photographie der Leber, der Milz und des Zwerchfells." *Deutsche Med. Wchschrft.*, 1914. No. 24, p. 1205.

STEIN, ARTHUR, and STEWART, W. H. "Roentgen Examination of the Abdominal Organs." *Ann. Surg.*, July, 1919, vol. lxx, No. 1.

STEWART, W. H. "Fracture of Skull with Air in Ventricles of the Brain." *Am. J. Roentgenol.*, vol. i, No. 2, p. 83.

SCHMIDT, A. "A New Radiological Procedure for Abdominal Diagnosis." *Deutsche Med. Wchschrft.*, Feb. 20, 1919.

WEBER, E. "Ueber die Bedeutung der Einführung von Sauerstoff resp. Luft in die Bauchhöhle für die diagnostische Roentgenologie." *Fortschr. a. d. Geb. d. Röntgenstrählen*, 1913, vol. xx, p. 453.

DISCUSSION

DR. CHARLES A. WATERS.—I should like to ask Dr. Stewart if he has had any experience in injecting the lesser peritoneal cavity, and if he has had any cases of tumor such as retroperitoneal sarcomata which are confused with hypernephromata.

DR. W. H. MANGES.—Dr. Stewart was kind enough to come to Philadelphia recently and show some of these slides and try to encourage us to do some of the work. Shortly after his visit a lady was sent to me from Delaware with the request that I examine her liver by the *x*-ray. That was all I had to go on. She was a large woman, and in addition to that her abdomen was enormously distended with fluid. Her tissues were mostly all edematous, and the heart shadow also was very greatly enlarged, although it had a practically normal heart-shaped outline. I realized at once the futility of making any effort to study the liver of such a patient. Her two daughters were with her and I tried to explain to them that it was a physical impossibility to get any information in regard to her liver in her present condition. I told them, however, that it seemed to be indicated at least that some of the fluid that she carried should be removed if for no other reason than to give her some relief. Now this lady had traveled on the train and by taxicab and walked into the hospital and was very much fatigued. She was persuaded to stay in the hospital a few days for study. To make a long story short, we tapped the abdomen and removed a large bucket-full of fluid and merely hitched an oxygen tank on to the same needle and inflated the abdomen so that it was in the same condition, as to tension, as it was before. We allowed the patient to stay in bed for about an hour and then brought her to the *x*-ray room. She got up and walked about the *x*-ray room with as much comfort as she had before. We examined her standing and lying and on her side, in every position, and it did not make any difference to her. Now that patient was in a pretty sick condition, so that I think that patients that can walk around, can walk just as well with the abdomen inflated as before.

The interesting point in this case was that the parenchymatous organs were perfectly normal in shape and outline, so that it was not

a case of cirrhosis of the liver nor a case of lesion of the kidney. That, taken together with the general picture of anasarca, showed that she did have a picture of myxedema and she improved under treatment for that condition.

Dr. A. H. Pirie.—I would like to ask Dr. Stewart if he has examined these patients standing up, and whether it is a safe procedure, and whether the organs falling down cause pain.

Dr. William B. Bowman.—In acute subdiaphragmatic conditions, such as a subdiaphragmatic abscess, is there not a certain amount of danger of the oxygen breaking up some newly formed adhesions with the resulting change of a local infection into a general one?

Dr. William H. Stewart.—This work is new. So far as we can ascertain it has never been done in this country before. There are, of course, many problems to solve, some of which I am not able to answer at the present time. We started the investigations in June. So far thirty-eight cases have been inflated and examined roentgenographically. The method must be adopted in all obscure abdominal lesions. You will meet with difficulties in obtaining support, but keep at it as we propose to do. All new and valuable methods meet with very little encouragement at first, even the bismuth meal received a cold reception when first advocated.

So far we have not been able to differentiate between the lesser and greater peritoneal cavity after inflation.

It should be of greatest value in the differentiation between hypernephroma and splenic enlargement.

In answer to Doctor Pirie, we would say that early in our investigations we examined the cases in the erect position, but they did not seem to take kindly to this position. After one patient had broken a Coolidge tube by using the tube-stand as a support, we discontinued. It was also found that most of the cases gave all the necessary information in the prone.

We were indeed pleased to have the support of Doctor Manges. It has been noted that cases which have had peritoneal effusions seem very tolerant to the inflation. This may explain why his patient was able to walk around with so little discomfort. We hesitate to endorse this procedure, however, believing that most of the cases should remain in the prone position while the distention is greatest.

It is possible that the oxygen might break up some newly formed adhesions. I feel, however, that one must take some chances in all methods of diagnosis. I am quite satisfied if I can clear up some obscure condition so that the patient is saved from an exploratory operation.

NON-TRAUMATIC EPIPHYSEAL SEPARATIONS

BY WILLIAM A. EVANS, M.D.

DETROIT, MICH.

THE frequency with which we have encountered both recent and old epiphyseal separations of the hip joint without a history of trauma leads us to make a more or less exhaustive study of the literature pertaining to epiphyseal separations and juxta-epiphyseal fractures.

Our interest in the subject was accentuated by a reversal of our diagnosis of spontaneous epiphyseal separation by one of the most prominent Eastern orthopedists. Without any hesitation whatever he declared that the condition was one of a fracture of the neck of the femur, and that the case had been maltreated.

All of the cases observed showing active symptoms were in patients of the adolescent period. Invariably these patients were of overweight and were oversized for their age. Of nine cases which came under observation, two occurred in girls and seven in boys.

The following case report is typical of all the cases, with the possible exception that the symptoms persisted over a longer period of time, and the permanent deformity was not as great as is most frequently observed:

CASE I, PLATE 1. June 19, 1917. The plate shows a slight decalcification of the osseous structures, and a little disturbance of the epiphyseal line. This is best shown at the lower margin.

CASE I, PLATE 2. Oct. 6, 1917. Same finding as plate I with a little more disturbance at the lower margin.

Miss S., age eleven and a half years, with a development of thirteen or fourteen years, was referred for roentgen examination of the hip in June, 1917. The history was that of lameness, apparently the result of some pathology in the hip-joint. The previous history indicated some symptoms in the knees, with the left showing the more pronounced symptoms, the symptomatology being confined to pain and a resulting limp. Nothing was revealed on physical examination, either locally or constitution-

ally. The plates which were obtained at this time showed a slight demineralization of the left pelvis in the immediate vicinity of the acetabulum, especially opposite the upper quadrant of the head of the femur. Special attention was paid to the epiphyses, the statement being made that there was a symmetrical appearance of the epiphyses both for the heads of the femora and of the greater and less trochanters. No attempt was made in the report to explain the slight bone change, it being stated that the same findings frequently suggested an early infection. After a period of rest, the symptoms subsided and the patient was able to spend the summer in a camp where she indulged in all the strenuous exercises incident to camp life, and not until she returned to the city in September was there any development of the former trouble. A second examination was made in October, 1917, and at this time there was noted the same mild osteoporosis of the structures about the left hip, but in addition there was reported a disturbance in the epiphyseal line at the head of the left femur. In offering a diagnosis at this time, we suggested the term "Non-Traumatic Epiphyseal Separation" of the head of the femur, a condition which we previously had held to be associated with adolescent rickets. It was following this examination, that the patient was taken East and had the case diagnosed as a fracture at the neck of the femur.

The literature is entirely concerned with the question of epiphyseal separations and juxta-epiphyseal fractures, and the etiological factor of trauma is always admitted.

One orthopedic school maintained that practically every case of epiphyseal separation of the upper end of the femur was really one of fracture. This is the view of Whitman, and he wrote freely on the subject; and no doubt many men in the East still hold the views which he presented.

CASE I, PLATE 3. March 29, 1918. Plate shows a wide epiphyseal separation with disappearance of the epiphyseal line.

CASE I, PLATE 4. May 7, 1918. End-result. Note condition of the coxa vera.

On the other hand, Hoffan and Sprenge[1] maintained that a fracture of the neck of the femur in childhood was rare, and that the usual injury consisted of an epiphyseal separation. We believe that this view has been borne out by the later experiences of many men, and this is the view which the writer has come to hold after a review of

our own cases; that is, that epiphyseal separations are much more common in children than fractures of the neck of the femur. However, we are not especially interested at this time as to the relative frequency of epiphyseal separations and fractures of the neck of the femur of traumatic origin in children.

We wish to limit ourselves to the type of cases in which as far as can be determined, trauma is not the etiological factor in the pathology. The etiological factor in epiphyseal separations has not been determined, but we are of the belief that it is the manifestation of some general condition, probably associated with disturbed internal secretion. As previously stated, all of the active cases occurred at the age of puberty and there was evidence of abnormal internal secretion, since the patients were all of the feminine type and showed excessive development.

It was suggested that lues was the etiological factor, but this was ruled out by the usual tests for this condition.

The fact that all our separations involve the hip joint only would offer no objection to the explanation for the condition, because the relations of the diaphysis and epiphysis at the head of the femur are peculiarly favorable to slipping, providing that there is a disturbance in the weight of the patient and strength of the parts.

The diagnosis of the condition is based, then, upon the history of pain in the hip joint and, in some cases, pain referred to the knee. The onset may be rapid or gradual, and the progress of the case may be acute, or in other cases interrupted by periods when no symptoms whatever present themselves. These symptoms, then, are at variance with those described in Robert and Kelly's treatise on fractures and in Tubbey's Disease of Bones and Joints, and in these works the only etiological factor given is that of trauma.

Stereoscopic plates made of the affected hip show a general loss of the lime salts, and more particularly a disturbance in the epiphyseal line, with slipping. The deformity is best shown by extreme external rotation of the thigh when the plates are made.

The severity of the symptoms and the extent of the deformity depend entirely, of course, upon the degree of separation. As

CASE VII, PLATE 5. Jan. 2, 1919. Plate shows an extreme epiphyseal separation with demineralization of femoral head.

CASE VII, PLATE 6. June 4, 1919. Result after appropriate manipulation and fixation.

in the case report given in detail, we believe that there is a degree of separation which is productive of symptoms but which cannot be demonstrated by the ordinary roentgen plate, and, too, the degree of separation may be so slight that while it can be demonstrated upon the plate, there is no deformity evident upon physical examination. The cases of extreme or complete separations offer no difficulty in diagnosis. inasmuch as there is present a shortening and rotation of the limb, and limitation of movements of the affected joint.

development of the two conditions is so distinct that there is no question in our minds that the type appearing during the period of adolescence is a distinct type. The writer is of the opinion that this condition should not be confused with Perthey's disease, which was fully described in an article by Dr. Frederick C. Kidner, of Detroit.

The prognosis in the condition depends, then, in the first place, entirely upon an early diagnosis, and upon the treatment adopted following the demonstration of an

CASE III, PLATE 7. Result of epiphyseal separation and non-treatment.

CASE IX, PLATE 8. End result. Non-recognized and non-treated epiphyseal separation.

From the roentgen examination alone, we cannot distinguish between the epiphyseal separation which accompanies a general condition and the separation which results directly from a trauma. Furthermore, we have noted that the condition is a progressive one, even in the case of the traumatic type of separation. It is this point which probably leads its supporters to the view that all separations result from trauma, they claiming that the original trauma may be overlooked. Of course the epiphyseal separation. In slight separations a good result will be obtained if the part is put up in a plaster cast with strong flexion and external rotation of the thigh. The period of fixation should extend over four or six months. In the cases of extreme separation, when the deformity has existed only a relatively brief time, a great improvement in the relations of the diaphysis and epiphysis can be obtained by proper manipulation. See Case VII, Plates 5 and 6.

COCCIDIOIDAL GRANULOMA *

BY WILLIAM B. BOWMAN, M.D.

LOS ANGELES, CALIF.

COCCIDIOIDAL GRANULOMA is a definite, acute, subacute or chronic disease due to an infection by a parasitic organism or mould-like growth called by Ophüls the Oidium Coccidioides. It is sometimes called the California disease owing to the fact that all of the cases reported, with but three exceptions, have either lived in or visited that State before contracting the disease. Not only have most of the cases lived there, but a large percentage of them have come from one district of the State, viz., the San Joaquin Valley.

Whether this disease is peculiar to California or not, no one at the present time can definitely state; personally, I am of the opinion that it is probably prevalent throughout the country, but owing to the fact that most of the profession are unaware of the existence of such a disease it still remains unrecognized; this statement being based on the fact that even the pathologist, if he is not on the lookout for it, is very prone to diagnose this disease as some form of tuberculosis.

The first case was reported in 1894 by Rixford of San Francisco, and later in detail by Rixford and Gilchrist, who at that time stated that the disease was due to a protozoa and called it pseudo- or coccidioidal tuberculosis. In 1892, Wernicke, and later Posadas, reported a case in Buenos Ayres, which in all probability was coccidioidal granuloma. In 1905, Ophüls reported twelve cases, and suggested the name coccidioidal granuloma, and proved beyond a shadow of a doubt that it was caused, not by a protozoa, but by a parasitic fungus or mould-like growth which he called the Oidium Coccidioides. In 1914, MacNeal and Taylor, in a résumé of the literature, stated that twenty-four definite cases had been reported up to that time. Dickson, in 1915, gives a detailed article stating that forty cases had been reported, thirty-five of the patients had been residents of California, three had visited the State, and twenty-seven had been residents of San Joaquin Valley in that State.

The oidium coccidioides occurs as a spherical body varying in size from seven to thirty microns in diameter. It consists of an irregular protoplasmic body with a double contoured, highly refractile surrounding membrane or capsule, and they multiply by sporulation. The fungus grows on all types of media. The mode of infection in the human is unknown. The pathology so far described, both grossly and histologically, especially in the viscera, has been practically identical with that of tuberculosis and a differential diagnosis could only be made by the isolation of the organism.

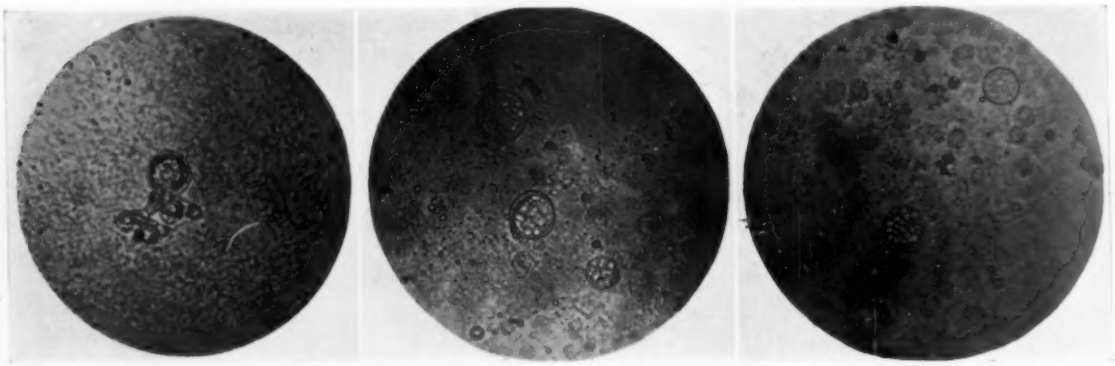
Rixford states that in bone conditions there is extensive destruction with formation of tubercle-like nodules and with large giant cell formations of the Langhans' type, and that it resembles both macro- and microscopically genuine tuberculosis. Hammock, pathologist at the Los Angeles County Hospital, states, however, that in bone and joint conditions it was noted both macro- and microscopically that the process seemed somewhat more acute than in tuberculosis. He also states that in three cases he noticed the tendency of the suppurative process to extend along the tendons and muscle sheaths to a considerable distance from the joint. The literature makes practically no reference to the roentgen findings in these cases.

A positive diagnosis can be made only upon the finding of the organism in the pus or tissues. This can easily be done by mixing a drop of pus with a drop of 10

* Read before the Twentieth Annual Meeting of THE AMERICAN ROENTGEN RAY SOCIETY, Saratoga Springs, N. Y., September 3-6, 1919.

per cent sodium hydrate on a slide with a cover slip. After a few minutes, when the pus cells have been destroyed, the parasites, which are much more resistant, are easily found. Dickson states in his article that a routine examination of cases clinically tuberculous, in which the tubercle bacillus cannot be found, would probably reveal a great many cases of coccidioidal granuloma.

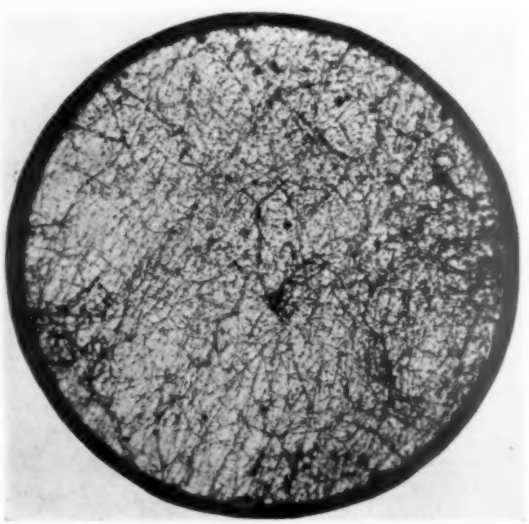
Through the kindness of Dr. J. Mark Lacey, Assistant Medical Director of the Los Angeles County Hospital, who has kindly given his permission, I now wish to present the case histories together with the roentgen findings of five patients afflicted with this disease, coming under our observation during my service as attending roentgenologist at that Hospital. In all of these cases, the positive diagnosis was made by the pathologist.



* Figs. 1, 2, 3. Showing the Oidium Coccidioides in Various Sporulating Stages.

Case I. Patient 90968 G. O., Mexican ranch hand. Entered the Los Angeles County Hospital Feb. 4, 1916, with an admitting room diagnosis of monarticular rheumatism and sent to the medical service. Complaint was that of pain and swelling of the left ankle; the pain had existed one month prior to entrance to the hospital, the swelling appeared a little later. The pain had come insidiously, and was aggravated by walking and exercise. This was not accompanied by a rise of temperature nor associated with a sore throat or tonsillitis.

Past history as to disease was negative except for an attack of gonorrhea in 1913. Denied chancre, and blood Wassermann was negative. Patient was born in Southern Mexico in 1891 (twenty-five years of age), and worked in different parts of Southern Mexico until 1910. He then came to Bakersfield, Cal., where he worked as track-hand on the railroad for a short time, then came to Los Angeles, and since that time has spent two, three or four months each year at Oxnard, Ventura County,



* Fig. 4. Showing the Microscopic Appearance of the Growth as it Appears on Artificial Culture Media.

* Plates furnished by Dr. Charles W. Bonynge, Bacteriologist, Los Angeles, Calif.

helping with the bean crop, mostly as a threshing hand.

His general condition became rapidly worse, his temperature being elevated to 101.2° in the afternoons with a morning temperature usually around 99° and 100°. Pulse rate increased from 90 to 120 before operation, performed by Dr. R. on Feb. 15, 1916, when a curettage of the bone of the ankle joint was done. Nothing was removed but bloody granular tissue, the joint being drained with a through and through drain. Microscopic examination of the curettings on section showed chronic inflammation with giant cell infiltration. Culture showed staphylococcus growth, and a diagnosis was then made of tuberculosis of the joint with secondary infection.

FIG. 5. CASE I. (PATIENT 90968). RIGHT ANKLE SHOWING INVOLVEMENT OF THE INTERNAL MALLEOLUS AND INTERNAL TWO-THIRDS OF ARTICULAR SURFACE OF THE TIBIA.

Patient's condition grew steadily worse, the right ankle becoming involved a short time later, and on March 21, 1916, Dr. R. again operated, doing a curettement of both the right and left ankle joints, removing necrosed bone and pus. Patient's general condition rapidly became worse. Microscopic findings from the results of the second operation were chronic granulation with endospore cells found resembling coccidioidal granuloma, giant cells being present in goodly number; and a diagnosis of coccidioidal granuloma was made.

Guinea pig inoculated intraperitoneally with pus developed typical lesions of coccidioidal granuloma.

Blood count at this time showed 8,500 leucocytes with a differential of 14 small mononuclear lymphocytes, 3 large mononuclear lymphocytes, 1 transitional and 81 polymorphonuclears.

Roentgen Findings.—Right ankle: small irregular areas of necrosis involving inner two-thirds of articular surface of tibia. Slightly irregular, fuzzy thickening of the periosteum of internal malleolus.

Patient died from the infection April, 1916.

AUTOPSY. 90968. Body greatly emaciated. Pus was present in the sinuses leading to the ankle joints and extended upward in the legs for a few centimeters along the tendons. Articular surfaces were roughened, and the bone immediately adjacent to the joint somewhat softened.

Lungs.—Scattered through the left lung were numerous small semi-gray nodules resembling tubercules. There were a few larger nodules with caseous centers. Similar nodules were seen in the upper and middle lobes of the right lung. All of the lower lobe except the anterior margin was firm and airless. The cut surface was smooth, gray, comparatively dry and had a gelatinous appearance similar to a gelatinous tuberculous pneumonia.

Esophagus.—In the esophagus on the anterior wall adjacent to a mass of enlarged peribronchial lymph-nodes was a deep irregular ulcer, and imbedded in its base was found an oat kernel in its hull. The lymph-nodes were adherent to the esophagus and the one immediately beneath and practically forming the base of the ulcer contained pus. Other peribronchial nodes were enlarged and firm; some contained necrotic areas.

Heart.—The pericardial cavity was al-

most entirely obliterated, and binding the parietal pericardium to the heart was a friable grayish granulation tissue. The heart muscle was brown, rather flabby. Valves thin and pliable; twice the normal size. Cut surface reddish brown. No focal lesions. *Gall-bladder* apparently normal. *Stomach* apparently normal.

Intestine.—Scattered through the lower portion of the small intestine were numerous ulcers, the largest about 2 cm. in diameter. These had elevated rather firm edges and irregular bases. Opposite the ulcers could be seen small gray nodules resembling tubercles. *Adrenals* apparently normal. *Spleen*, normal size, soft, no focal lesions.

Kidneys.—Negative except for slight cloudiness of cortex. *Bladder* and *prostate* apparently normal.

Microscopic examination of the lesions revealed changes similar to those caused by the tubercle bacillus, except that there was less tendency to fibrosis, and polymorphonuclear leucocytes were more numerous than in most tuberculous lesions. Parasites were found in the ulcer of the esophagus, in the pneumonic lung, in the discrete nodules of the lung, and in the pericardium, being especially numerous in the latter.

CASE II. Patient 105911 D. B., eighty-three years of age, Negro, male, entered the hospital March 31, 1917, with an admitting room diagnosis of infected ankle joint, and was sent direct to the surgical service.

The complaint consisted of pain and a moderate amount of swelling in the left ankle joint. It had been opened somewhere before entering the hospital. The onset was supposed to have been acute, beginning about two months before, but not accompanied with any systemic disturbances or elevation of temperature except for a rise to 99.2° in the afternoon with a pulse ranging from 80 to 114.

Past history, negative; denies disease of all kinds; blood Wassermann negative. Has worked about horses all his life, the past twelve years having been spent in Los Angeles as coachman, and later as handy man about the home of a physician in that city.

On April 10th, ten days after admission, the left ankle joint was curetted, necrotic bone and pus being removed. Microscopic examination of the pus showed many spherical refractile bodies 15 to 30 microns in diameter with double contoured walls and granular cytoplasm. Some of the

FIG. 6. CASE II. (PATIENT 105911). LEFT ANKLE. Note beginning destruction of articular surface of tibia with small area of involvement on posterior surface of bone.

larger ones were filled with very numerous spherical bodies which are endospores. From cultures there grew on several occasions, a fungus with white fluffy cotton surface, turning brown after a few days at the edges and next to the agar. Smears from cultures showed only mycelium.

On May 1, 1917, the left leg was amputated by Dr. C., at the middle one third. This wound healed very slowly; the general condition was good and the patient left the hospital on June 4th, in fairly good condition, there being only a scanty discharge of sero-sanguinous material. Subsequent reports from time to time have been to the effect that the wound has remained practically healed all the time,

although at times there has been a slight semi-purulent discharge.

A guinea pig inoculated intraperitoneally with pus from the lesion died after five weeks. Autopsy showed numerous tubercle-like nodules in lungs and spleen, a few in the liver and a suppurative orchitis. Numerous typical spherical organisms were found in these lesions.

Roentgen Findings.—Left ankle: Artic-

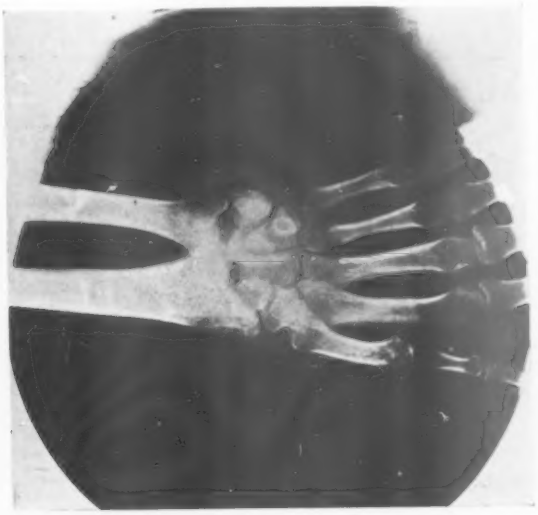


FIG. 7. CASE III. (PATIENT 107525). LEFT WRIST SHOWING MARKED INVOLVEMENT OF ARTICULAR SURFACE AND LOWER END OF RADIUS. Note the displacement and early involvement of the semilunar.

ular surface of the tibia slightly irregular, hazy, and showed beginning destruction of the articular surface of the joint. Small area of rarefaction on posterior surface of tibia. Finding typical of a tuberculous joint.

CASE III. Patient 107525 B. B. Male, Mexican, fifty-four. Entered the Los Angeles County Hospital, May 20, 1917, with a diagnosis of right psoas abscess and an infected left hand. Complaint consisted of pain and pus discharge from the left wrist, the wrist having become swollen at some time previous and incised, from which wounds there persisted a most purulent discharge. Pain and swelling in the right lower quadrant, on physical examination proved to be a solid tumor of about the size of the patient's two fists.

Past history as to diseases was negative, denied syphilis, and blood Wassermann gave a negative result. He has worked in and about Los Angeles County as a ranch hand, having the care of horses, for the past ten years.

Smears taken from the pus of the wrist show many spherical bodies 20 to 50 microns in diameter, with doubly contoured membrane. Many show division of protoplasm into many spheres (endosporulation). Cultures show much bacterial growth, though after five days the typical growth of coccidioidal imitis appeared.

Patient was taken from the hospital June 20th, seven days after admittance, and from subsequent information we learned that a fatal termination was reached a few days later, no autopsy having been performed.

Roentgen Findings.—Left wrist: Marked destruction of articular surface of radius, the bone having a punched out appearance such as seen in some cases of joint tuberculosis. Outer border of radius shows a roughened, irregular, fuzzy thickening of the periosteum. Apparent dislocation of semilunar and scaphoid. The semilunar shows beginning involvement.

CASE IV. Patient 109024 T. B. Male, Mexican laborer, twenty-eight. Ranch hand, living in Los Angeles County for past eight years in vicinity of East Lake Park. Entered hospital June 22, 1917.

In September, 1916, went to Merced County, San Joaquin Valley, and worked on ranch, returning December, 1916. In October, 1916, developed "malaria" which resisted treatment until early in January, 1917, when left index finger began to swell and became very painful, though he attributed this to an injury. Later, a subcutaneous nodule appeared on scalp and another over the left zygoma, other fingers began the same way as the first, and pain appeared in the knees and left wrist.

All infected fingers were then amputated, right patella was removed, and left knee and wrist opened and drained; later left leg was removed at level of upper and middle one-third of thigh.

Most of the wounds healed very slowly, and on September 21st patient left hospital, still having discharging sinuses of left wrist and right knee and stump of left thigh.

Jan. 30, 1918, patient still alive. Has been up and about in wheel chair. Arm soft tissues. A typical picture of tuberculosis of the wrist and hand.

Right knee: Patella has already been removed. Articular surface of both bones and particularly of the femur is hazy, irregular, with diminished density and blurring of anterior surface of lower end of femur. Soft tissues show considerable increase in density.

FIG. 8. CASE IV. (PATIENT 109024). LEFT WRIST AND HAND SHOWING COCCIDIOIDAL INVOLVEMENT OF LOWER END OF RADIUS, ULNA, ALL CARPAL AND SECOND, THIRD, FOURTH AND FIFTH METACARPAL BONES.

FIG. 9. CASE IV. (PATIENT 109024). RIGHT KNEE. Note absence of patella. Shows involvement of articular surface of both the femur and tibia with considerable increase in density of soft tissues.

CASE V. Patient 111871 E. L. Male, Mexican laborer, forty-eight. Entered Los Angeles County Hospital September 7, 1917; diagnosis, ulcer of foot.

Eight months before entering hospital patient lived in Calexico, Imperial Valley, working in cotton fields. Had lived in Los Angeles four years previously, and in San Joaquin Valley eighteen years ago for a period of six months. Had worked very little with animals, but always on ranches with hay and grain. Eight months ago injured right ankle, and swelling and pain have existed ever since. He claims that a physician treated the sprain three months ago and immediately afterwards a sinus formed, since which time several other

very badly involved, all lesions extensively broken down and exuding characteristic pus. Immense cauliflower granulations are seen in each lesion. Attending surgeon states that he may advise patient to return here for amputation of this extremity.

Roentgen Findings.—Chest and spine negative. Left hand: All carpal and proximal, one-third of second, third, fourth and fifth metacarpal bones poorly defined. There is marked destruction of these bones, including the articular surface of radius and ulna, considerable increase in transparency, and blurring of the outline of same and thickening of the surrounding

sinuses have developed discharging thin purulent material. Ankle very painful and swollen.

Past history negative. Blood Wassermann negative. Fresh smears showed the organisms of coccidioidal granuloma; culture showed abundant growth after seven days' incubation, and guinea pig inoculation intraperitoneally showed characteristic lesions in all viscera and especially the genitalia. Patient showed no elevation of temperature while in the hospital and was otherwise in best of health. When amputation was suggested he left the hospital, refusing to give a future address.

Roentgen Findings.—Right ankle: Small circumscribed area of rarefaction in lower end of fibula. Tip denuded of periosteum with some bone destruction. Internal malleolus shows marked bone destruction with considerable irregularity and fuzzy thickening of the periosteum. Not a typical tuberculous ankle. Advised Wassermann, although hardly enough proliferation present for a syphilitic joint. Roentgen diagnosis reserved.

At the time of examination the clinical diagnosis was tuberculosis, and while the clinical and roentgenological department were trying to agree on a diagnosis, the pathological department isolated the organism of coccidioidal granuloma.

I am also indebted to Doctors Ruggles and Bryan of San Francisco for the privilege of presenting one of their case reports and lantern slides of a case of coccidioidal granuloma of the lung.

Case VI. W. H. Male, age fifty-four, single. Occupation, farmer. Patient entered University of California hospital, May 11, 1918, with complaint of "multiple abscesses."

Family history unimportant. Past history negative, except that he lives in Visalia and comes in contact with horses and cattle.

Present complaint: Patient dates beginning of trouble to September, 1917, when he suddenly developed headache, temperature of 105° and a cough accompanied by substernal pain. Two weeks later numerous small pustules developed over entire body, progressing slowly and ter-

Fig. 10. Case V. (Patient 111871). Right Ankle. Lateral view.

Fig. 11. Case V. (Patient 111871). Right Ankle. Note the peculiar, irregular, fuzzy appearance of periosteum on internal malleolus.

minating in spontaneous rupture or surgical drainage, followed by persistent sinuses. Cough subsided for a few weeks, but reappeared, and has persisted since that

FIG. 12. CASE VI. Note coccidioidal involvement of the upper left lobe. Autopsy showed changes in the right lung to be due to malignancy.

time. Slight hemoptysis on various occasions. Patient had lost 65 pounds in nine months.

Examination of body showed numerous chronic pustular lesions in varying stages from suppuration to healing. Cultures of both the pus and sputum showed oidium coccidioides. Wassermann, negative.

Therapy.—Sodium iodides, no results. Tartar emetic, no results. Copper sulphate, both internally and locally, no results. Autogenous vaccines, no results.

Roentgen Findings.—Pulmonary tuberculosis.

Patient died November 30, 1918.

Autopsy Findings.—Left lung coccidioidal granuloma. Primary carcinoma of the central portion of the right lung.

The roentgen findings in all these cases to my mind greatly resembled those of tuberculosis, the peculiar irregular, fuzzy appearance of the periosteum, being the only distinguishing feature.

It may be well to bear in mind in the future when dealing with suspected tuberculosis of bones or joints that possibly it may be a case of coccidioidal granuloma, and I trust that further investigation will assist materially in aiding us to make a definite positive roentgen diagnosis of this disease.

BIBLIOGRAPHY

RIXFORD AND GILCHRIST. Two cases of Protozoan (Coccidioidal) infection of the skin and other organs. *Johns Hopkins Hosp. Rep.*, 1896, Vol. 1.

OPHÜLS, WM. Coccidioidal Granuloma. *J. Am. M. Assn.*, October 28, 1905.

MACNEAL, W. J., and TAYLOR, R. M. Coccidioides Immitis and Coccidioidal Granuloma. *J. Med. Research*, Bost., July, 1914.

DICKSON, E. W. Oidiomycosis in California with special reference to Coccidioidal Granuloma. *Arch. Int. Med.*, December 15, 1915.

DISCUSSION

DR. M. P. BURNHAM.—Dr. Bowman's paper is the first roentgen presentation of this rare and usually fatal disease. I will add four brief case reports and show slides of two. Case 1 represents an unusual instance of early diagnosis made by aspiration of a joint and followed by immediate amputation of the shoulder, based on the findings, and the man has remained apparently well.

This case is one of the cases of all reported to date that did not terminate fatally and would tend to show that if diagnosis is made early and radical surgery instituted a larger percentage of recoveries might be expected.

DR. HOLLIS E. POTTER.—Dr. Bowman asked me to say a word about the lesions in this disease as compared with those of blastomycosis seen and described in Chicago. Eight or ten years ago there was considerable discussion on this point between pathologists and clinicians. About that time I published in our journal seven cases of bone lesions in systemic blastomycosis, which brought out the following *x*-ray findings for blastomycosis: (1) In the short bones the findings were those of simple necrosis without periosteal reaction. (2) In the long bones an intense necrotic process was seen at the ends of the long bones beneath the epiphyseal line. At bone ends not bearing an epiphysis the lesion lay directly under the joint surface. Surrounding the end of the bone was a mature osseous periostitis which was

very striking in amount. Secondarily openings were burrowed through this involucrum and pus discharged into the surrounding tissues to form the deep subcutaneous abscesses common to the disease. Seldom were the joints involved, and then only by this burrowing process.

As you see from Dr. Bowman's slides the lesions of coccidioidal disease produce a less apparent liquefaction necrosis in the subepiphyseal region, have a less pronounced and more ragged periosteal reaction, and show changes in the joints affected. These are the first slides I have seen from this California disease and I confess having thought the lesions were identical with blastomycosis.

Dr. G. E. Pfahler.—I would like to ask Dr. Bowman what the treatment is for this condition. It has seemed to me from observation that there has been less general atrophy than one finds in lesions of tuberculosis, and that the disease is more sharply separated from the surrounding bone. From some of the slides it would appear that the bone was increased in density in the neighboring parts, while in tuberculosis there is a decrease.

Dr. H. K. Pancoast.—I have understood from talking with Dr. Bowman that the appearance of the chest in coccidioidal granuloma was practically the same as in early tuberculosis, and it seems to me that the Society would be interested another year in hearing from him a paper on the lung manifestations of this disease.

Dr. L. T. LeWald.—I wonder whether Dr. Bowman would not regard that as dislocation of the wrist, the semilunar retaining its relationship. I have seen one case in which there was a separation of the mid-row of carpals. I think in one of the slides that Dr. Bowman showed, the semilunar retained its relationship with the radius, but the os magnum had slipped backward and gave a prominent appearance to the semilunar; it was not, however, true dislocation of the semilunar.

Dr. William B. Bowman.—In regard to Dr. Moore's question as to whether or not a routine examination was made of the lungs, will say that in only three of these cases were the lungs examined. In all three, the roentgen findings were negative.

In regard to Dr. Pfahler's question as to the treatment of the disease, I will read first the therapy given in some of these cases: Sodium iodide, no result; tartar emetic, no result; copper sulphate, no result; autogenous vaccines, no result. Personally, I would like to see some of these cases treated with the *x*-ray. If *x*-ray will cure blastomycosis, it might have some therapeutic action on this disease, but there is nothing in the literature on this subject, with the exception of one reference in Dickson's article, in which he stated the *x*-ray had no results.

In regard to the question as to whether the organism is the same as that found in rabbits, will say that it is not. The name of this disease is really a misnomer. It is due to a mould-like growth and not due to protozoa.

REPORT OF TWO CASES OF XERODERMA PIGMENTOSUM WITH MALIGNANCY OF THE EYEBALL SUCCESSFULLY TREATED BY ROENTGEN RAY*

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XERODERMA PIGMENTOSUM is a disease of the skin characterized by extreme atrophy, pigmented spots, and later by the development of malignant growths. The condition resembles to an astonishing degree a chronic *x*-ray dermatitis, or the malignant degeneration we sometimes see in the aged. It nearly always starts in childhood and occurs in family groups. The two cases herein reported are brother and sister. According to the patients' statement, a similar condition prevailed in the father's sister, the father's father and the father's grandfather. The striking peculiarity in our cases was the occurrence of malignant lesions of the eyeball, involving both eyes in one case and one eye, the right, in the other case.

FIG. 1. CASE I. RESULT AFTER TREATMENT. The right eye is artificial, having been lost after unsuccessful treatment by operation and radium.

CASE I. Lena R., female, aged sixteen. Referred August 1, 1917, by Dr. Stanley Smith for treatment of a malignant lesion of left eyeball. About one year ago, a small growth appeared on right eyeball which was removed by Dr. Smith and section made, which proved the growth to be carcinomatous. It returned in a short time and was treated by radium, but the treatment was unsuccessful and the eye had to be removed. About one year later, a similar growth appeared on the left eyeball at the cornea-scleral junction on the nasal side. It increased rapidly in size and as operative and radium treatment had proven unsuccessful in the other eye, Dr. Smith immediately referred this case for *x*-ray treatment. At that time she had a reddish yellow growth, wedge shaped, about $\frac{3}{8}''$ long, $\frac{1}{8}''$ wide at base of wedge and elevated to a height of about $\frac{1}{6}''$.

Because this patient had but one eye, we proceeded very cautiously with the treatment, and used a technique entirely different from the one we usually employ for superficial carcinoma. The eye was first cocainized to enable the patient to open the eye wider and to hold the eyeball still; a mask of tin foil was fitted, with an opening corresponding to the lesion. About one-third of an erythema dose was applied at each sitting, no filter being used. Treat-

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ments were applied every third day with occasional intervals of rest of a week or ten days. Fifteen treatments were given in all, the last being given Oct. 4, 1917, two months after the first. At that time the growth had entirely disappeared, only a small transparent scar remaining. The condition has remained cured to this date, two years later. In addition to the lesion on the eyeball, this patient had innumerable pigmented spots all over the face and forehead, some of which had broken down and formed small ulcerations. She said these spots had been present as long as she could remember, although her mother said that when she was a small baby she had not a blemish on her skin. We called in consultation Dr. John G. Burke, who pronounced the case one of xeroderma pigmentosum, and advised us to try *x*-ray treatment on the skin lesions, as no known treatment was particularly successful. We treated in all eight discrete epitheliomata which had ulcerated, using the regular massive dose treatment commonly employed for epitheliomata. In addition, we treated the entire forehead, which was thickly sprinkled with keratotic pigmented spots, with smaller doses through a thin filter. The ulcerated areas all responded to treatment and the condition generally was much improved. At this time there are no areas on the face which could be called malignant, although the skin is much atrophied and there are many scars and many pigmented spots. The final outcome of this case is of course problematical, but the remaining eye has been saved and the disease on the face halted for the time being. From the manner in which the epitheliomatous lesions of the face responded to *x*-ray treatment, I would feel quite hopeful of keeping this case going indefinitely, provided she seeks treatment promptly as soon as fresh lesions occur.

FIG. 2. CASE II. Note tumor on inner side of right eyeball.

FIG. 3. CASE II. Result after treatment; no appreciable scar.

CASE II. Justine R., male, age sixteen. This boy is a brother of Case I. He presented himself on June 16, 1919, with a growth on the right eyeball on the nasal side of the cornea, slightly smaller than

the one described in his sister's case. He had noticed it only a few days before and came immediately for treatment. He also had many pigmented spots on the face, and several small ulcerations, one of which had the typical pearly indurated borders of an epithelioma. Owing to the peculiar interest of these two cases, I had consultations on both with two dermatologists of Pittsburgh, Dr. Lester Hollander and Dr. H. G. Wertheimer. The diagnosis of Xeroderma pigmentosum was agreed upon by both these gentlemen, and the same treatment was carried out in this case as described in Case I. Small fractional doses were applied, since the result in the first case was so satisfactory, although I am of the opinion that massive doses could have been used with the same success.

In fact, in the interval between the treatment of these two cases, I treated successfully a malignant growth on the eyeball, almost as large as a grape, with one massive dose. However, we deemed it expedient to treat this case in a manner similar to Case I, and accordingly ten treatments were given of about one-third erythema dose each every third day, the last treatment being given July 28, 1919. At this date, August 30, 1919, the lesion has disappeared, leaving no appreciable scar. We also treated five small epitheliomata scattered about the face by the massive dose method and these have all yielded to treatment. The general condition of the skin in this case is not so bad as in Case I, and I believe we can cure up the epitheliomata by *x*-ray treatment as fast as they develop if he comes in promptly for treatment.

THE OPEN METHOD OF SURGERY IN DEEP-SEATED RECURRENT CANCER PREPARATORY TO ROENTGEN AND RADIUM THERAPY*

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THE RELATIVE ABSORPTION OF RAYS BY SKIN, FAT AND MUSCLE, AS COMPARED WITH VARIOUS THICKNESSES OF ALUMINUM *

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TECHNIQUE OF RADIOTHERAPY *

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THE roentgenologist is at a great disadvantage when he is to apply deep therapy to recurrent deep-seated carcinoma. Such cases are usually referred to him by the surgeon, because further surgery is inadvisable and because he wishes to preserve the hopes of the patient who, in his despair, is most anxious to try something more which might save his life.

Surgeons as a rule do not expect very much from radiotherapy. They recommend the treatment partly because there is nothing else to be done, and because they do not wish to deprive the patient of the possible chance of cure which this treatment might accomplish, for we do not as yet know its possibilities. The pessimism of the surgeon is in a large measure justified, because statistics in the past have shown that deep-seated recurrent carcinoma cases have rarely been permanently benefited by roentgen or radium treatment. But does this indicate that they never will be? Have we exhausted all our means to perfect the treatment of these cases? Shall we give up in despair, or shall we increase our efforts and improve our means to crush this most malignant foe of man?

I am convinced that radiotherapy will in the future increase its usefulness in the treatment of cancer, and we must keep on working unceasingly on the problem. One of the most essential requisites for efficient radiotherapy in recurrent cancer cases is the proper preparation of the cancer field, and this important factor is overlooked by surgery. The surgeon heretofore has not prepared the area for treatment for the roentgenologist so that he may apply roentgen therapy to its full capacity. To this particular shortcoming on the part of surgery I have given attention during the past few years, and have carried on certain experimental work (here reported) which I trust will lead a step forward in the treatment of some recurrent types of carcinoma.

This, then, is only a preliminary report on the experimental work done at the North Chicago Hospital on these apparently hopeless cases of recurrent, deep-seated carcinoma. Each case in which the treatment here described has been em-

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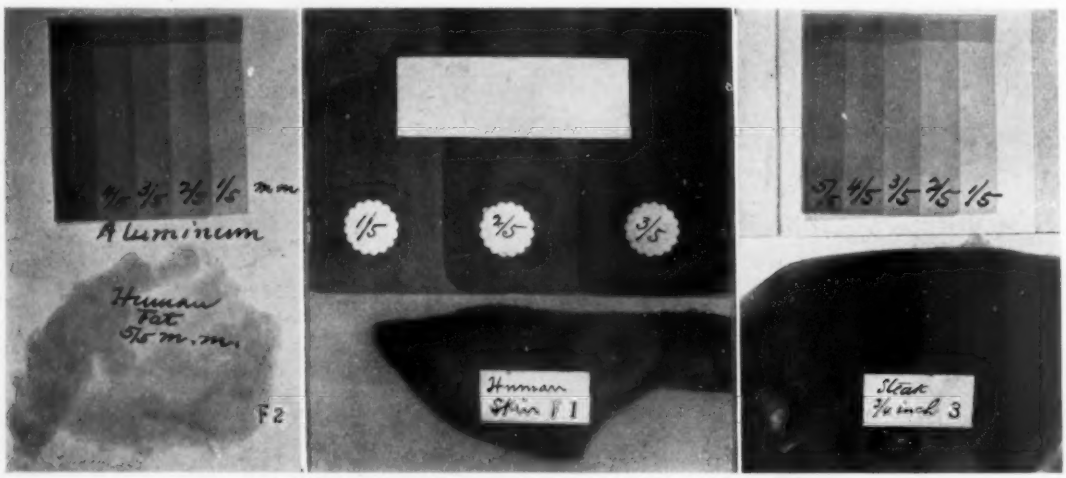
ployed has had previously at least one or more surgical operations, always with recurrence, and in each care all further treatment was considered valueless.

Method of Treatment.—The treatment consists of radical surgery followed by deep therapy. In this one apparently finds nothing new. Surgeons have for many years advocated deep roentgen therapy subsequent to surgical operations for cancer, and no doubt a great deal has been accomplished in this way. The new feature which I desire to add is the transformation of the deep-seated cancer field into a superficial one in the recurrent cases, thus preparing it for effective roentgen or radium therapy. To achieve this *I recommend the removal of all tissues, skin, fat, muscle, and as much of the tumor as feasible, leaving the cancer bed widely exposed in order that the rays may penetrate directly into the seat of the malignant growth.*

It is a well-known fact that superficial malignant growths, such as epithelioma, respond readily to *x*-ray and radium treatment, while deep-seated growths do not. The cause for this is very suggestive. The skin, fat, and subcutaneous tissues which usually overlie deep-seated cancer, are dense filters for the penetration of the *x*-rays. They absorb most of the softer rays from the *x*-ray tube and allow only a small quantity, namely, the hard rays, to penetrate deep enough to reach the growth. Such small quantities of radiation, instead of destroying the cancer cell, may stimulate it to more rapid growth. It therefore suggested itself to me that if we could remove the skin and all the overlying tissue and as much of the growth as feasible, and leave a large area entirely exposed, and then apply either *x*-ray or radium directly to the open wound, we might by this method obtain results similar to those usually obtained in superficial growths.

The physicists teach us that the rays emanating from radium consist of three varieties: alpha, beta and gamma rays.



FIGS. 1, 2 AND 3. ILLUSTRATE THE COMPARATIVE DENSITY OF SHADOWS OF VARIOUS THICKNESSES OF ALUMINUM, AS COMPARED WITH A CERTAIN THICKNESS OF HUMAN SKIN, FAT, AND MUSCLE.

The alpha rays constitute 91 per cent of all the rays emanating from radium, the beta rays about 7 per cent, the remainder, gamma, only about 2 per cent. The alpha rays are very readily absorbed by thin metal foil or even by the air. Rutherford states that a thickness of 6/1000 cm. of aluminum or mica, or even a sheet of ordinary writing paper, is sufficient to absorb completely all the alpha rays. Most of the beta rays are absorbed in 5 mm. of aluminum or 1 mm. of lead. Only the gamma rays will penetrate these filters.

The density of tissues depends upon the close packing of the molecules which

compose them—in other words, on their atomic weight. In fat, for instance, the molecules are far apart, while in the skin or muscles they are more closely packed, and in metals such as lead or silver the molecules are extremely dense. The shadows on the photographic plate of these different substances give us an approximate indication of the molecular composition. Lead will produce a very dense shadow, while fat or muscle will give a correspondingly lighter shadow. For a rough working rule it may be taken that *the thickness of matter required to absorb any type of rays is inversely proportional to the density of the substance.*

the penetration of the *x*-rays; it produces a shadow on the *x*-ray plate equal to that of three-fifths of a millimeter of aluminum, because of the arrest of the rays by the skin. Where the underlying tissues, such as muscle, fat, and fascia, absorb still more of the rays, it is most likely that very few of the beta rays ever reach the deep-seated tumor. Thus we deprive ourselves of the action of the greater part of the most effective rays emanating from radium, namely, the beta rays. Even the gamma rays lose some of their intensity in passing through the skin and subcutaneous tissues.

To determine just how much of the *x*-ray is absorbed by the skin, fat, and

FIG. 4. ILLUSTRATES IN THREE CASES OPERATED IN JULY, 1919, THE EXTENT OF REMOVAL OF TISSUES OVERLYING DEEP-SEATED CANCER OF THE NECK. Short histories in text.

Thus the alpha rays have very little effect in the treatment of either superficial or deep-seated growths. The beta rays, however, are about one hundred times as penetrating as the alpha rays and the gamma rays are from ten to one hundred times more penetrating than the beta rays. The alpha rays may therefore be entirely ignored as far as the treatment of cancer is concerned, and we must depend entirely upon the action of the beta and gamma rays. Are we at present utilizing the beta and gamma rays to their full extent? Answer: We are not. The skin, being the densest of all the soft structures of the body, is itself quite an obstacle to

muscle, we have two methods at our disposal: One is the *photographic* method and the other the *electroscopic.*

I have made the following experiments by the photographic method to determine the quantity of *x*-ray absorbed by the tissues:

1. A piece of *skin*, free of fat, removed from the knee of a young man, was placed on an *x*-ray plate and beside it were placed three strips of aluminum of various thicknesses: .2 mm., .4 mm. and .6 mm. thick respectively. Comparing the shadows produced by the aluminum with that of the skin upon the plate, we can estimate approximately the relative amount of rays

absorbed by the skin. (See Fig. 1.) It appears that the skin absorbs about as much as three-fifths of a millimeter in thickness of aluminum, which is considered by roentgenologists a substantial filter for the rays.

2. A layer of *fat*, ½ inch thick, was placed along a series of five aluminum filters ranging in thickness from .2 mm. to 1 mm. A radiogram for comparison of these two substances was made in a way similar to that in the case of the skin experiment, and it is shown that one-half inch of fat will arrest on the average as many rays as two-fifths of a millimeter of aluminum would filter. (Fig. 2.)

included. Their measurements show that our photographic estimates are approximately correct.

Taking these physical characteristics of the rays into account, I have therefore concluded that in order to have a full measure of the effective *x*-rays reach the tumor, we must remove the obstruction to their passage, namely, the skin, the fat and muscle, and as much of the tumor as possible. The procedure will be best understood by the illustration of cases, because the operation must of necessity be different in each case.

For illustration I cite four cases of different types from a larger series in which

FIG. 5. COMPLETE CLOSURE OF WOUNDS SUBSEQUENT TO RADICAL OPERATION WITH PLASTIC. Recurrence took place after this operation. FIG. 6. SUBSEQUENT OPERATION, LEAVING WOUND OPEN, RADIUM INSERTED. FIG. 7. GROWTH OF SKIN IN THE DEPTH OF EXCAVATED BONE SUBSEQUENT TO RADIUM TTREATMENT. Patient under observation.

3. The same experiment as No. 2 was made with *muscle* tissue. A piece of beefsteak, ¾ inch thick, was placed alongside the filter-scale and the shadow produced by the beefsteak is at least three times as dense as that obtained from 1 mm. of aluminum. (Fig. 3.) Thus it would appear that three-quarters of an inch of muscle would be capable of absorbing most of the beta rays from radium.

The measurements of the absorption of rays by means of the electroscope are more accurate, and have been conducted through the courtesy of Professor Millikan at the Ryerson Laboratory of the University of Chicago. The report of this work is here

this treatment has been employed. We must bear in mind that we are attempting the almost impossible and cannot expect that a magic cure will follow in miraculous fashion in every case. If we can improve only in a small degree upon previous methods, we are taking a step in the right direction, which may finally lead to fruitful results.

The method is based on scientific principles, and while the number of cases thus far treated is not sufficiently large to draw definite conclusions, the results are encouraging enough (considering the hopelessness of these cases) to justify us in its application. The patients are usually per-

fectly willing to undergo one more operation, because they have usually lost all hope of getting well.

To what extent we may go in the removal of the tissues overlying the cancer, is illustrated in Fig. 4, showing three cases of recurrent carcinoma of the neck, all of whom I operated in July, 1919, being treated with radium and *x*-ray. The complete histories of these three cases will appear in future publications when time will permit us to make comments upon the efficacy of this method. At present I can speak only of the extent of the operation.

In Case A, I have removed the submaxillary gland and all the tissues overlying it, including the skin, fat, and muscles covering the transverse remus of the mandible. You note that the mandible is entirely bare and exposed. Into this deep crater the radium or *x*-ray is applied.

In Case B, a more radical operation was performed, the external ear was temporarily displaced and the internal ear was curetted, part of the cheek removed, and the entire area of the neck, including the supraclavicular region, which was exenterated and left exposed. The carotid and jugular in this case were excised.

In Case C, a similar procedure was pursued, the jugular was divided, but the ear in this case was not involved and therefore was left intact. The depth of the wounds is best demonstrated by viewing the stereoscopic pictures.

FIG. 8. REMOVAL OF SUPRA-CLAVICULAR INVOLVEMENT SUBSEQUENT TO REMOVAL OF THE BREAST. Wound left open.

FIG. 9. COMPLETE CLOSURE WITHOUT RECURRENCE 7 MONTHS SUBSEQUENT TO OPEN METHOD OF RADIUM AND *X*-RAY TREATMENT.

CASE REPORTS

Carcinoma of Jaw—Open Method for Deep Therapy.—H. H., age sixty, developed a carcinoma of his lower left lip, which was removed in July, 1915. In 1917 he developed carcinoma of the glands in the neck. A radical operation was performed in October, 1917, by myself, resection of the submaxillary gland and all the lymphatics on that side, as well as a resection of the tumor in the mouth and part of the lip. A large amount of skin overlying the maxillary bone was removed

and a flap of skin was shifted over to cover the defect. Healing took place within two months (Fig. 5); but by July, 1918, recurrence had extended to the lower maxillary bone. Another radical operation was performed; I resected the lower part of the transverse ramus of the lower jaw and all the overlying tissue, and curetted the ascending ramus of the jaw. This time, however, the wound was not closed, in order to allow the radium and *x*-ray treatment to be given directly into the center of the disease. (Fig. 6.)

Under this treatment healing took place rapidly, the skin gradually grew over the denuded area. (Fig. 7.) The patient remained perfectly well until April, 1919, when he developed severe headache and earache. It was uncertain whether there was any recurrence high up under the cranium, but there probably was. There was no recurrence, however, in the neck or at the seat of the operation which was treated by the exposed method. The patient is still under observation. Lesson: The last operation should have been more radical.

Recurrent Cancer of Breast—Supraclavicular Denudation.—Dr. J. C., age forty-eight, married, one healthy child. Developed carcinoma of her left breast in June, 1918. Although it was rapidly growing and she was fast losing in weight, she refused the removal of the breast until September, 1918, when all axillary glands were involved and a noticeable mass was seen above the clavicle. The breast was removed in September, 1918, with radical removal of all glands and muscles below the clavicle, but not above. Daily *x*-ray treatment was given after the operation to reduce the involvement in the supraclavicular region, but instead of a reduction the growth increased in size and the arm became swollen.

I then decided upon the removal of the skin, fat, and all cancerous involvement above the clavicle within reach. This was done on January 21, 1919. An area of 3 inches in width and 5 inches in length was denuded; the clavicle was entirely exposed; as much diseased tissue above the clavicle as was feasible was extirpated; no attempt was made to close the wound. (Fig. 8.)

Through the wound daily *x*-ray treatments for one month were given, and radium was applied once a week for 12 hours. The crater gradually filled up with what appeared to be normal granulation tissue. February 1, 1919, we began application of adhesive plaster along the edges of the wound for the purpose of favoring regeneration of the skin. This proved satisfactory, and at present the entire wound is covered with dry skin and no recurrence of the cancer has as yet taken place (Aug. 14, 1919). (Fig. 9.) Patient has regained her former weight and resumed her practice.

Cancer of Neck with Recurrence after Two Operations. Third Operation with Open Wound. No Recurrence.—Mr. A. L. M., fifty-four years old, developed a cancer of the lip early in 1916. The same was excised and for several months there was no recurrence. In November, 1916, several glands in the region of the sternocleidomastoid were found and a radical excision of the same was made. Recurrence took place after this operation. Patient would not submit to a more radical procedure until the tumor was of considerable size, when in March, 1919, a very radical operation was performed by us. *X*-ray treatment and radium were then applied almost daily over the sutured wounds, but recurrence took place as quickly as before, and within three months there was a tumor the size of an orange in the submaxillary region, the original seat of the trouble.

In this desperate condition the patient presented himself to me and I proposed the open method of treatment, which was carried out as follows: A circular flap with the base pointing to the lower jaw was lifted up and all of the tumor mass that could possibly be removed was eliminated. The skin flap was then pushed underneath the inner ramus of the jaw and kept there by gauze packing. This left the wound exposed. (Plate I in colors.)

Into the depth of this wound 10 milli-

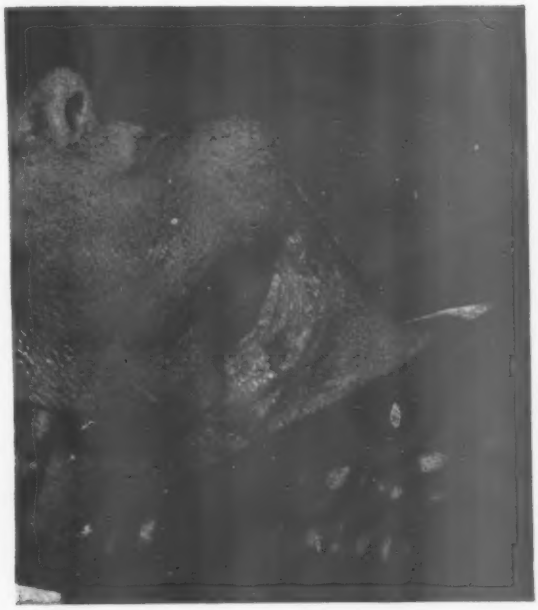


Plate I. Removal of recurrent carcinoma (third operation), wound left open, for radium.

Plate II. One and a half years after operation, denuded surface entirely covered with new skin grown from the edges, no recurrence up to date, patient gained 30 pounds.

Stereophotograph A. Open operation in recurrent carcinoma of inguinal glands.

grams of radium element were inserted for 24 hours. This was repeated every week, besides the daily exposure of the wound to the *x*-ray. The patient began to gain in weight rapidly (20 pounds to date), the skin began to grow into the wound by the aid of adhesive plaster, and now, one year and a half later, the patient is in perfect health without a sign of recurrence. (Plate II.)

Another illustration of the extent to which we may proceed in resecting carcinoma in the inguinal region is shown in

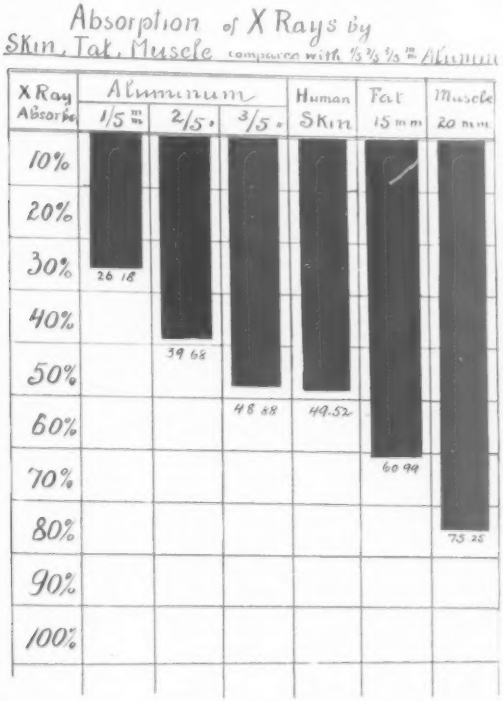


FIG. 10. CHART DEMONSTRATING RELATIVE ABSORPTION OF *X*-RAY BY VARIOUS SUBSTANCES.

the colored Lumière stereophotograph. In this case there was a most extensive involvement of the inguinal glands, the lower part of the abdominal muscles and the glands in Scarpa's triangle, subsequent to a primary carcinoma of the scrotum. All the tissues overlying the tumor and as much of the tumor, including Poupart's ligament, as possible, were removed in January, 1919, and the large surface shown in the picture left open for subsequent radium and *x*-ray treatment.

Rapid improvement followed at first, and all vestiges of the tumor almost disappeared, so that the patient could travel to Detroit to be presented before the Midwinter Meeting of the Western Section of the American Roentgen Ray Society; but later metastatic tumors appeared in the right inguinal region, which were excised early enough to prevent involvement of the deeper structures. Unfortunately, the patient had a severe hemorrhage from an erosion of the femoral vein on the left side, the first involved, which caused his sudden death.

Whether there will be any recurrence of metastatic tumors in other parts of the body is another question. It is likely that there will be. The susceptibility to cancer recurrence in what is called a cancer individual may still remain even if the growth in a particular region is destroyed.

It has been stated by some observers that there are changes in the entire body after the *x*-ray treatment which immunize the patient against a recurrence; but this is too large a subject to be discussed in this paper.

What becomes of this large denuded surface after the growth has apparently disappeared? The skin from the borders of the wound will gradually grow from the edges and cover the entire surface with the aid of the adhesive plaster method, which I have published in the *Annals of Surgery*, April, 1919. This growth of skin in itself is proof that the cancerous growth has been eliminated, because healthy epithelial cells will not grow over cancer tissue. But I have observed in the cases treated that the skin will cover large surfaces which formerly contained masses of cancerous tissue.

I present this subject in this immature state merely that others may try it and help perfect the surgical as well as the roentgen technique. It certainly can do no harm, and may accomplish some good to these poor individuals who have nothing to look forward to but misery and death.

DR. WARNER'S PAPER

A HYDROGEN tube with tungsten target was used, excitation being produced by a transformer and rotary rectifier (Victor). The absorption was measured by an ionization method. The distances 16 and 32 inches refer to the distances from the target to the window of the ionization chamber. The numbers are percentages of the total incident rays absorbed; e g., one aluminum screen absorbed approximately 25 per cent of all the rays falling upon it in the conditions given in Table I. The aluminum screens were of standard type but varied from 0.20 to 0.23 mm. in thickness. Since the time of exposure was of necessity very short, and because the effect from equal short intervals of time are not equal (due to the variations in the primary current), no attempt was made to keep the time intervals constant, but in general it was somewhat longer for the 32-inch distance than for the 16-inch distance.

In Table I two sets of data were taken for the 16-inch distance for each absorbing substance. A comparison of these results shows that the per cent of variation is in all cases less than 1 per cent. Comparing the results for the two distances shows that for short distances there is practically no difference in the percentage of absorption, hence in the remainder of the work the 32-inch distance was used.

In Table II the same absorbing substances were used as in Table I but with the addition of three other substances. The heterogeneous rays were obtained with the same conditions as before except that the voltage and consequently the current through the tube were increased slightly. The medium hard rays were obtained by screening out the soft rays, by interposing a piece of plate glass between the tube and the ionization chambers.

The great variation in the two samples of skin is easily accounted for by the fact

TABLE I

Absorbing Substance	Conditions: Victor H. Tube, Tungsten target. Spark 5 inches. Current 1.2 milliamperes. 16 inches	32 inches
One Al screen	25.06	
	25.18	24.07
Two Al screens	37.48	
	37.14	37.18
Three Al screens	45.40	
	45.04	45.06
1st sample skin	46.45	
	46.65	46.48

TABLE II

Absorbing Substance	Conditions: Victor H. Tube, Tungsten target. Spark 5.5 inches. Current 1.6 milliamperes. Distance 32 inches. Hetero-geneous	Medium Hard
One Al screen	26.18	
Two Al screens	39.88	
Three Al screens	48.88	
1st sample skin	49.32	
2nd sample skin	17.91	8.08
Fat 15 mm. thick	60.99	31.49
Beef 20 mm. thick	75.25	42.88

FIG. 13. ILLUSTRATES THE COMPARATIVE FIGURES OF RAY ABSORPTION BY VARIOUS TISSUES.

that the first sample was much thicker and of more uniform thickness than the second.

The slight increase in percentage absorption with increased voltage would at first seem to indicate that the absorption is greater for hard rays than for soft: but since when all the soft rays are screened out by interposing the plate glass the percentage absorption is cut down approximately one half, the explanation is no doubt that while increased voltage did produce some harder rays it also produced a proportionally greater number of soft rays, thus increasing the percentage absorption for the heterogeneous beam. The very great decrease in percentage absorption for the harder rays seems to be a plain indication that the fleshy tissues are quite transparent to hard rays.

It is usually unwise to attempt to draw a conclusion from incomplete data; but it seems safe in this case to predict that a few centimeters of body tissues would act effectively as a screen for nearly all the soft rays, but would be quite transparent to hard rays. Hence if it be the soft rays that are valuable in therapeutics the removal of parts overlying the diseased organ is quite essential: but if hard rays are the valuable ones, then removal of the overlying tissues seems unnecessary.

DR. EISEN'S PAPER

WHEN treating cancers in which the overlying skin and other tissues have been cut away, the treatment becomes practically the same as in epithelioma. The only difference lies in the amount of *x*-rays or radium given; the quality of the rays remains unaltered. The time of exposure depends upon the depth to which the cancer reaches and upon the toleration of the patient to the rays. It is therefore obvious that no two cases can be treated alike, and each individual application is dependent upon the patient's general condition.

The local reaction of the rays cannot of course be judged by the reaction of skin to the rays. Until this new treatment was introduced, the amount of rays given to a cancer was dependent upon the toleration of the overlying skin. The limit which the skin tolerates is that causing a reddening (an erythema) within twenty-four hours. This is called an erythema dose and differs according to the locality of the skin, but varies only within certain limits, and can be accordingly pretty accurately estimated.

With the removal of this skin, the appearance of the cancer-bed and surrounding tissue furnish the signs for measuring the permissible dose. This dose, in our experience, has been many times the dose tolerated by the skin. We have given ten, twenty, and even more full skin or erythema doses in as many successive days. Such doses could never be given when skin covers the cancer. A superficial green-colored necrosis, less than $\frac{1}{8}$ inch thick, follows this rapid-fire treatment. In a few days, the dirty-looking connective tissue returns to its original pink, in which the scattered islands of persistent cancer areas still remain discolored. Later this deeper necrosis sloughs away, the easy-bleeding cancer islands reappear, the treatment is then renewed.

The only filter against the soft rays of longer wave length used is a four thickness piece of gauze placed over the wound and a sheet of writing paper placed over this. No other screening material is used. To insure greater stability and easier management, the tube vacuum is kept very high (12-inch back-up) and the amount of rays generated is very small ($\frac{1}{2}$ milliampere). This makes the repetition more exact and also insures a large amount of the more efficient soft rays, as the tungsten spectrum for rays of different back-up will easily demonstrate.

It is needless to say that the body.

except the raw wound surface, is accurately covered with material (lead rubber) impervious to the rays. The tube is brought down as near the wound surface as possible (about 6-inch focus distance). Sometimes it is unavoidable to expose some point of the skin, which then becomes edematous and temporarily painful. It has also happened that the protected skin has become hyperæmic in highly sensitive patients, either through the amount transmitted through the protective material or possibly through secondary rays generated in the patient's body.

Sleeplessness, loss of appetite, and general weakness are the signs of general toxemia. At this point further treatment is for a time suspended. At no time have patients become ill during or shortly following the treatment, which lasts between five and ten minutes, never longer. It is too early to give a more extensive report, inasmuch as the method is in the experimental stage.

LATE RESULTS OF WAR INJURIES TO THE CHEST

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THIS meeting will have achieved a helpful end if it impresses upon our minds the advancement in medicine and surgery during the past few years, although for part of our knowledge we have paid dearly in the hundreds of thousands of lives lost and shattered. What seems rather remarkable is that the war has failed to produce anything new or startling in medicine; but it is the aggregate of smaller refinements and perfections which mark the great progress in the past five years. Probably the greatest advance in any branch of medicine during the war has been in thoracic surgery.

During the first two years of the war very little was attempted surgically for gunshot wounds of the chest, as in civil practice experience had demonstrated that the best method was to treat these cases expectantly. With the very large number of extensive wounds of the chest demanding treatment, and showing a general mortality of over 30 per cent, chest wounds became regarded as among the most serious of all war injuries, and surgeons began to apply more heroic methods in order to save the lives of these patients.

Duval, Gask and others, disregarding the old established theory of negative pressure, began to treat these wounds exactly as they would similar wounds in other parts of the body, thus reducing the mortality to about 9 per cent. They found that the thorax could be widely opened, the collapsed lung delivered through the wound, the lung incised, foreign bodies removed, and the lung sutured; the pleural cavity washed out, and the pleura, chest wall and integument closed in turn by primary suturing, without causing either shock or injury to the patient.

The principal causes of death in chest wounds are infection and hemorrhage; therefore the greatest success followed in those cases which were operated upon within a few hours after injury. Duval states that as a rule it is best not to perform any operation after 30 hours. He recommends immediate thoracotomy under the following conditions:

1. In cases of serious hemorrhage.
2. Open thorax and mechanical difficulties in respiration (sucking wounds).
3. Foreign bodies retained in the lungs, unless very small.
4. All wounds of the lungs complicated with fracture of the ribs.
5. Wounds of the lungs with an intrapulmonary hematoma.

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The success which has followed this newer method of treating lung wounds in carefully selected cases, must not blind us to the great danger involved in opening the thorax. It has been proven that very few rifle bullet wounds give trouble unless the bone is injured; and shell fragments, if small, can penetrate the chest wall and lodge in the lung without apparently causing any permanent damage. If the ribs are splintered or if the wound of entrance or exit is large and there is reason to suspect that particles of clothing or foreign material have been carried into the wound, débridement should be practiced in the same way as in other parts of the body.

Col. Rudolf of the C. A. M. C., in collecting notes on patients in the Canadian hospitals in England with foreign bodies in the chest shown by *x*-ray examination, cites 50 cases. Two of these were operated upon for the removal of foreign bodies, and both patients died; one from hemoptysis eleven days after operation, and the other from pulmonary thrombosis on the third day. Of the 48 not operated upon, 29 were returned to full duty, 7 to light duty, and 12 were invalided to Canada. Thus 72 per cent were fit for some form of military duty while 14 per cent were lost to the army.

Col. Elliott, F. R. C. P., of London, gives a list of 170 cases of gunshot wounds of the chest, in which the after history had been traced. He states that the only case that had a fatal termination was one in which there had been an operation for the removal of a rifle bullet from the lung. A foreign body remained in the chest in 51 of his cases, without apparently increasing the gravity of the prognosis in any instance.

My own personal experience and observations in wounds of the chest have not been great, for the wounded whom I saw at the Base Hospital at Camp Upton, N. Y., were for the most part convalescing from injuries received from two to ten months previous to their entrance into the hospital. Out of 568 roentgen examinations of the chest, made in January, February, March and April of this year, 33 were referred because of injuries to the thorax. These presented quite a variety of conditions.

Eight had through and through wounds of the chest with absolutely negative roentgen findings.

Two had double scars, with evidence of an empyema on the affected side, one showing the presence of fluid. Neither of these cases had been operated upon.

Two showed localized areas of increased lung density in the region of the scars.

Seven showed extensive thoracic wall wounds with injury to the clavicle, scapula or to one or more ribs. All of these showed visceral changes, ranging from slight thickening of the pleura to obliteration of all lung detail on the affected side. Three of these cases were draining.

One had a persistant hemothorax, not infected. This case was aspirated on Jan. 13th and again on March 9th, and over 1500 c.c. of a bloody serum was withdrawn both times. This man gave a history of having had fluid withdrawn several times in France.

Seven had foreign bodies in the lungs; 5 of these failed to show any fibrosis or thickening of the lung structure surrounding the missile. The largest of these foreign bodies was a machine-gun bullet which appeared to be suspended in space when the plates were viewed stereoscopically. One of these patients had had a radical operation with a resection of a part of the 6th rib, and there was a small foreign body near the base of the right lung. There were no signs of thickening of the pleura or of pulmonary changes, and had it not been for his history and the absence of the rib, one would never have suspected that a thoracotomy had been performed. In none of these cases was there evidence of abscess formation around the foreign body.

Six had foreign bodies in the chest wall, one showing several fragments beneath the integument.

With very few exceptions these patients looked and seemed well, and most of them were anxiously waiting to be discharged. Very few complained of any discomfort except a slight cough and occasional pain. These symptoms appear to be quite common, especially where there is a foreign body in the lung. How much of this discomfort is imaginary is a question yet to be determined, as it has been frequently observed that symptoms do not develop until the patient has become aware that his body is harboring a shell fragment or bullet.

In giving this general outline of the principles involved in the treatment of these cases, it is not with the idea of presenting anything new, but simply to emphasize the importance of the subject, as many of these patients after being discharged from the service will seek medical advice.

It is of the utmost importance in the treatment of these cases that there should be the closest cooperation between the skilled surgeon, the clinician and the roentgenologist. The roentgenologist must furnish very exact information as to the shape, size and location of the foreign body, the presence and extent of a hemothorax, pneumothorax or empyema, the extent of injury to the bony framework, the condition of the opposite lung, the position of the heart and movements of the diaphragm.

From the experience thus far gained it seems probable that in the immediate future the great majority of penetrating wounds of the thorax will still be treated by the expectant method, and by surgical cleansing of the external wounds. There will be comparatively few injuries that will require thoracotomy, but Gask, Duval, Lilienthal and others have demonstrated what can be safely undertaken in chest surgery, and it is not too much to expect that in the near future many of the disfiguring and protracted empyemas, lung abscesses, localized tuberculosis and new growths may be treated with far greater success by opening the thorax than by any of the older methods.

REFERENCES

Duval, Pierre. "Gunshot Wounds of the Lungs, and their Treatment at the Front." *Surg., Gynec. and Obst.*, 1919. XXVIII, No. 1.

Gask, G. E. and Wilkinson, K. D. "Penetrating Wounds of the Chest." *Brit. M. J.*, 1917. XI, p. 781.

Rudolf, R. D. "The Later History of Cases of Gunshot Wounds of the Chest, with Retained Missiles." *Lancet*, 1917. XI, p. 709.

Bradford, Sir J. Rose. "Gunshot Injuries of the Chest." *Brit. M. J.*, 1917. XI, p. 141.

Roberts, J. E. H. and Craig, J. G. "The Surgical Treatment of Severe War Wounds of the Chest." *Brit. M. J.*, 1917. XI, p. 576.

Elliott, F. R. "Treatment of Chest-Wounds." *Lancet*, 1917. XI, p. 371.

Lilienthal, H., Brickner, N. W., Kellogg, W. A. "Thoracic Injuries." *J. A. M. A.*, 1919. LXXII, p. 839.

ANALYSIS OF 1300 CASES REFERRED FOR GASTROINTESTINAL STUDY, WITH SPECIAL REFERENCE TO THE IMPORTANCE OF CHEST EXAMINATION OF SUCH CASES *

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AND
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THE danger of limited examinations is well recognized by the best clinicians, and has been repeatedly emphasized. The importance of a more general roentgen survey in cases that are more or less obscure is also recognized by the roentgenologist; but the fact that both clinician and roentgenologist are derelict in this respect cannot be disputed.

The roentgenologist as a rule is only an accessory to this very obvious shortcoming, as the patient comes to him from the clinician with a request for an examination of some particular anatomical region or system; and with the meager clinical data at hand, it is but natural that he should follow the clinician's instructions to the letter. Indeed, at times when he presumes to violate these instructions his course is resented, until the physician referring the case is conclusively shown that it makes for more accurate diagnosis and a better understanding of the case in question. Cooperation is merely a matter of mutual understanding and confidence.

The fact that gastrointestinal symptoms frequently have their source of origin in lesions above the diaphragm is not sufficiently recognized. In order to emphasize this, the authors have undertaken an analysis of 1300 cases referred to them during the past two years for gastrointestinal examination. Of the 1300 cases our records show that a complete examination of the chest, both by stereoplates and the fluoroscope, was made in 807; fluoroscopic observation only was made in 304; and in 189 there is no record of the chest having been examined.

In tabulating our findings in these cases we have endeavored to record only definite pathology, and have eliminated as far as possible doubtful diagnoses and minor conditions which seemed to have no bearing on the case in question. Of course even with the utmost conservatism a certain degree of error is inevitable, as in a laboratory such as ours it is impossible to follow all cases to an ultimate diagnosis, either pathological or clinical. A variation in percentages in different laboratories is also to be anticipated, due to a difference in the character of the material handled, and the class of men referring cases.

Of the 1300 gastrointestinal cases forming the basis of this report we were able to demonstrate actual pathology in 506, or a little less than 39 per cent. Of this number the lesion was found to be in the chest in 170, or a little more than 13 per cent, or by excluding the 189 cases in which the chest was not examined, a little more than 15 per cent. In other words we found only about twice as many more gastrointestinal lesions than chest lesions in cases referred for gastrointestinal study.

It will be at once apparent that if our statistics are to have a practical rather than an academic interest, it must be shown that the chest lesion was an important or a prime cause of the morbidity in these cases.

With respect to the lung lesions this question can unhesitatingly be answered in the affirmative. This group comprised 98 cases, of which 84 were tuberculosis. The remaining 14 comprised cases of pleural effusion, unresolved pneumonia, spontaneous pneumothorax, malignant disease, pleural adhesions and bronchiectasis. The tubercular cases comprise about 6.5 per cent of the total number referred for

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gastrointestinal study, or more than 7.5 per cent of the cases in which the chest was examined. Coincident lesions of the lung and gastrointestinal tract were noted in only 6 cases.

The gastrointestinal symptoms which initiated a request for examination of the alimentary canal were of secondary origin in practically all of this group. Most of the tubercular cases were of a chronic, slowly progressing type, many of them showing extensive infiltration and fibrosis, but which nevertheless had escaped recognition throughout years of semi-invalidism. Of course a number of fairly early lesions were recognized, but this proved rather exceptional. It is of interest to note that we found pulmonary tuberculosis in almost exactly the same percentage of cases as duodenal ulcer, and it would thus appear that the two lesions are worthy of equal consideration in cases referred for gastrointestinal study.

The cardiovascular group comprised 69 cases, or slightly more than 6 per cent of the cases in which the chest was examined. A conspicuous enlargement of the heart or aorta was the determining factor upon which the presence of pathology was predicated. There was one case of aortic aneurysm. No attempt was made to determine accurately the heart volume by the more approved methods, our estimate being based solely upon visual impressions gained from observations made under standard conditions. The relationship of the cardiovascular lesions to the morbidity in this group of cases could not be determined with the same degree of assurance as in the pulmonary group, but it is certain that in many cases the roentgen observations in reference thereto were of great value in rounding out a diagnosis. It is to be noted that coincident lesions of the cardiovascular and digestive systems were more than twice as frequent as in the pulmonary group. These were noted in 11 of 69 cases of the former group, and in only 6 of 98 cases in the latter.

There is one important point in regard to the technique of chest examinations which we feel deserves special emphasis. We are convinced that fluoroscopic observations are not to be relied upon to the exclusion of stereoscopic plates. We believe all will agree with this conclusion; nevertheless we have been led to believe that there is a disposition on the part of some to rely on the easier and cheaper method, particularly in the examination of the chest in gastrointestinal cases. A minimum of error can only be obtained by a routine employment of both methods.

The accompanying table will show the pathological findings both in the chest and gastrointestinal tract of the 1300 cases forming the basis of this report. The percentages with respect to the chest lesions are estimated on a basis of 1111 cases, which comprise the total number in which the chest was examined.

TABLE SHOWING COMPARATIVE INCIDENCE OF CHEST AND GASTROINTESTINAL LESIONS IN CASES REFERRED FOR ROENTGEN STUDY OF THE ALIMENTARY CANAL

CHEST LESIONS

	No.	Per Cent
Pulmonary tuberculosis	84	.075+
Pleural Effusion	4	.003+
Unresolved Pneumonia	4	.003+
Spontaneous Pneumothorax	1	.001−
Malignant Disease of Lung	2	.002−
Pleural Adhesions	1	.001−
Bronchiectasis	2	.002−
Enlarged Heart	25	.022+
Dilatation of Aorta	43	.038+
Aneurysm of Aorta	1	.001−
Intrathoracic Thyroid	3	.002−
TOTAL	170	.150+

GASTROINTESTINAL LESIONS

	No.	Per Cent
Carcinoma of Esophagus	2	.001+
Cardiospasm	21	.016+
Gastric Carcinoma	24	.018+
Gastric Ulcer	33	.025+
Gastric Syphilis	3	.002+
Pyloric Obstruction	12	.009+
Duodenal Ulcer	89	.068+
Duodenal Diverticulum	8	.006+
Gall-Bladder Adhesions	14	.012+
Gall-Stones	18	.013+
Organic Lesions at Outlet of Stomach of Doubtful Nature.	42	.032+
Intestinal Obstruction	3	.002+
Appendix Disease	26	.02
Colitis	2	.001+
Carcinoma of Colon	5	.004−
Diverticula of Colon	1	.001−
Colonic Adhesions	33	.025+
TOTAL	336	.255+

SOME OBSERVATIONS ON THE RADIOGRAPHIC FINDINGS IN A SERIES OF CHESTS EXAMINED AT A BASE HOSPITAL IN FRANCE *

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WHEN we began this series we had hoped to make it more exhaustive than this present report would indicate, but owing to the changes forever occurring in the Army we were compelled to conclude with what we have presented here.

Our purpose was to determine as far as possible just what permanent structural changes, if any, took place in the lung tissues after inhalation of war-gases. In the main, we tried to secure cases who had a definite history of "gassing" as shown by the history card. We tried to exclude any with acute pulmonary conditions existing at the time of the examination.

In order to establish some differentiation if possible in the radiograph between changes due to such conditions as the recent "flu," the pneumonias, tuberculosis, or the effects of dust inhalation from exposure on hikes, etc., and gas inhalation, the cases examined are separated into five groups.

1. Those with a history of gas inhalation, with a negative pulmonary history: 32 cases.
2. Those with a history of gas inhalation, with a history of "flu" or pneumonia: 5 cases.
3. Those with a gas history, but referred by the clinician because of suspicious tuberculosis: 5 cases.
4. Those with positive recent pulmonary history without a history of gas inhalation: 34 cases.
   a. Influenza alone: 18.
   b. Pneumonia, bronchial or lobar: 8.
   c. Bronchitis: 4.
   d. Both influenza and pneumonia: 4.
5. Those with a negative pulmonary history and no exposure to gas, with exposure to dust irritation from long hikes, while in service: 11 cases.

It should be observed that virtually all gave a history of exposure to dust. Beginning with the last group, those with a negative pulmonary history but who had had a fair amount of dusty hiking, we found neither clinical signs of moment nor any radiographic evidence of pulmonary changes. Our conclusion was that the fact of exposure to dust inhalation from marching should have no influence on any radiographic findings in this class of cases.

The fourth group consisted of those with positive recent pulmonary history but without a history of gas inhalation. By "recent" we include a period within a year of the examination, but clinically not suffering to any great extent. Of the first subdivision of this group, namely, those with a history of "flu" alone, the findings were negative in two cases. Fourteen presented definite increase in the hilus shadows with a tendency in all toward extension along the basal trunks into the bases, particularly on the right side. These basal shadows were in almost all instances more marked than those often met with in radiographs of apparently normal lungs. This observation coincided with the clinical picture in a number of cases, where râles, ranging from harsh to fine crackling râles, were heard at the bases and mainly on the right side. Three cases, in addition to the hilus and basal changes, showed a fine beading along the bronchi and bronchioles, distributed evenly on both sides and all lobes. Three presented a "matted hair" appearance or interlacing of the finer linear markings at the periphery.

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Of these three, two had had pneumonia some years previously.

The second and third divisions of this group, those presenting no history of influenza, but with a history of pneumonia, presented only a tendency to increased peribronchial markings.

The fourth division, of which there were four cases, including those who had had both influenza and pneumonia, all showed a marked increase in peribronchial thickening and heavier hilus shadows with the basal shadows exaggerated.

The third group of five cases included those who had been definitely "gassed," but were referred by the clinician because of suspicious tuberculosis. All of these cases presented old calcifications in the hiluses, but no evidence of active tuberculosis. The peripheral markings, however, all presented the same fine, linear, interlacing or hair-net appearance seen in the cases included in Group 1.

The next group of five cases consisted of those with a history of gas inhalation but who had also had some pulmonary infection (pneumonia or influenza). Every case in this group presented marked increase in the hilus shadows, definite peribronchial thickening, often more marked at the bases, with the peripheral linear markings sharply defined, presenting again the "hair-net" appearance of the first group.

The last group to be considered, or the first group in the classification, 32 in number, were those who gave a history of "gas" inhalation with a negative history of recent pulmonary infection.

Three cases showed no definite changes. The remainder showed well defined linear markings at the periphery throughout both lungs. The hilus shadows were usually less dense than in Group 4, but often wider than normal and of a soft filmy character. A number showed discreet studdings along the bronchi. These changes were in the majority of instances confined to the middle and lower portions of both lungs. Rarely, if ever, were the upper portions and apices involved. The peripheral shadows were the most striking feature of this group. As before intimated, the appearance was not unlike matted hair. The linear markings were distinct, fine lines, interlaced, both peripheral and between the bronchioles, and throughout both lungs, mostly the middle and lower lobes. This is probably due to the fibroid changes resulting from the interstitial inflammation from which all apparently suffer immediately following the attack. Almost all of them had been exposed to the gas from three to four months previous to the examinations, which were made in January, 1919, most of these boys having been gassed in September and October, 1918. Virtually all still suffered from a dry and unproductive cough, and a sense of constriction or suffocation when in a crowded room.

The radiographs were made in the erect posture, stereoscopically, the rays passing postero-anteriorly.

CONCLUSIONS

Although I realize this is too small a number of cases to warrant the establishment of any definite conclusions, I gathered from this study that:

1. Exposure to dusty hiking produces little if any pulmonary pathology.
2. The effect of the so called "flu" is mainly upon the hiluses and peribronchial tissues, and basal rather than along the middle and upper trunks.
3. Inhalation of war-gases, it would seem, produced a fibroid thickening of the parenchymal tissues as well as of the finer bronchioles. This gives us a radiograph which appears not unlike fine matted hair at the periphery of the lung shadows and between the bronchioles, in other words, a pneumonitis.

I was greatly assisted in the choice of cases and their clinical study by Capt. Ralph M. Tyson, M. C.

MALIGNANT DISEASE OF THE LUNGS, ITS EARLY RECOGNITION AND PROGRESSIVE DEVELOPMENT, AS STUDIED BY THE ROENTGEN RAYS*

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PRECEDING the study of the chest by means of the roentgen rays, an antemortem diagnosis of malignant disease of the lungs, according to Warfield, was not made in a large percentage of cases because of the general good condition of the patients and the indefinite symptoms which this disease produces. Even with the study of the chest by means of the roentgen rays, I am sure that the disease is generally not recognized in its earliest stages. In its very earliest stages I believe that it cannot be definitely diagnosed by any means. In its latest stages it should not be mistaken by any roentgenologist. By reviewing the roentgenograms of a large number of cases, some of which have been followed over a period of several years, during which we have studied the progressive changes in the lesions, and by reversing the study, we have been able to trace the gross lesions back to their very incipiency. As a result, I am hoping that we shall be able to recognize this disease much earlier than it has ever been recognized heretofore. There is, of course, a microscopical stage in its development at which time we can never hope to recognize the disease.

Its early recognition will serve as a guide in the treatment. In some instances it will prevent a mutilating operation, and I am hoping in the future that its early recognition may lead to the early institution of some form of constitutional treatment which is as yet undiscovered. I am sure that at present many patients are operated upon with the hope of complete recovery at a time when there is already distinct metastasis in the lungs and mediastinum. On this account I believe we should urge a roentgen examination preceding all operations for carcinoma of the breast. When the lesions within the chest are doubtful, I believe that they should not stand in the way of an operation.

Malignant disease of the lungs may be divided into primary and secondary (or metastatic).

Primary Malignant Disease of the Lung is rare. It is of two types: the nodular and the infiltrating. The nodular type consists of nodules developing near the roots of the lung, but also in the parenchyma, and consists of varying sized masses, rather sharply defined and irregularly outlined. The infiltrating type, which is the more common, begins at the root of the lung and gradually infiltrates the entire lung. This fills the whole chest, and may come on so gradually, and produce such indefinite symptoms, that the disease is not suspected until the entire lung has become filled, and until one side of the chest is entirely solid, associated with marked displacement of the heart and mediastinal tissues to the opposite side, and associated with the early formation of pleural effusions.

The symptoms associated with primary malignant disease of the lungs consist usually of dyspnea, pain, with or without pleuritic friction, and dullness varying with the degree of the involvement of the lung. As a result of the extensive dullness, the first thought is a pleural effusion, but in aspirating the chest only a relatively small amount of fluid is obtained, and this is generally a bloody serum. When bloody serum is obtained in a relatively small amount, malignant disease should always be suspected, and a roentgen examination should be made if it has not been made

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previously. By means of the roentgen rays one recognizes an opacity in the early stages consisting of a mass of infiltrating dense tissue about the root of the lung spreading towards the periphery. If the malignant disease is sarcoma, it is especially apt to extend outward along the septum between the upper and middle lobe on the left side, or about the middle lobe on the right side, and this may be a fairly early sign. If the primary malignant disease is carcinoma, it consists of an infiltrating mass about the root of the lung extending outward along the bronchial tree, I believe most frequently in an upward direction, which serves somewhat to distinguish it from the inflammatory infiltrations about the root of the lung which tend to spread downward. In the late stages the whole of one side of the chest is a uniform dense mass with displacement of the heart and mediastinal tissues to the opposite side, with generally clear lung on the opposite side. The lung area on the opposite side may be reduced to one-third or more of its normal size. In less advanced stages the apex of the lung and also the lower portion of the base may remain clear, unless there is associated pleuritic effusion. Sometimes by varying the position of the patient this lower portion of the base of the lung can be demonstrated to be clear by displacement of the fluid upwards.

Secondary or Metastatic Malignant Disease of the Lung is very common, and I believe much more common than has been recognized up to the present time. In a quotation made by Warfield in the report of cases studied in Middlesex Hospital, he states that metastases were found in the lungs of 178 out of 516 autopsies performed on persons who had died from cancer of the breast, and he states that at least one-third of all patients dying from cancer of the breast have metastases in the lungs. It would seem to me, from my studies, that the proportion would be even higher than this. Gross found in 432 autopsies, collected from various sources, metastases in the lungs in 49 per cent. (Quoted by Rodman, p. 214.)

Metastatic Sarcoma, in my experience, has mostly followed sarcoma of the testicles, though it may, of course, be secondary to sarcoma anywhere in the body. The lesions are nodular and occupy more particularly the parenchyma of the lungs. They are generally sharply defined and vary in size from a small pea to an English walnut, or rarely as large as an orange. The emboli are probably carried to the lungs in the blood stream and distributed in the terminal blood vessels in the parenchyma. In none of the cases studied by me did the patients have any lung symptoms, and the disease in the lungs had not been suspected by the physicians who referred the patients—generally for treatment of some local recurrence or some other metastasis. This condition of metastatic sarcoma of the lungs occurs so frequently, in my experience, that I never start treatment of a sarcoma without examining the chest, and when metastatic sarcoma of this kind is found within the chest, the roentgen treatment has been of no avail.

Hypernephroma metastasizes early to the lungs, and I believe the chest should be examined in every case in which hypernephroma is suspected, or whenever hypernephroma has been diagnosed. In one case sent to me for postoperative treatment three weeks after the operation for hypernephroma, in which the patient's general condition was good and there was no thought on the part of others as to recurrence or metastasis, I made an examination of the chest and found undoubted evidence of infiltration of the lungs. This consisted, not of nodules, but of a general infiltration of small miliary bodies extending outwards from the roots of the lungs, which somewhat resembled an infiltrating tuberculosis, but the lesions were more sharply defined and did not follow the usual distribution of tuberculosis. The appearances were sufficient to make a diagnosis when associated with the history, and the subsequent development

proved that my diagnosis was correct. I am not sure that the diagnosis could have been made from the plates without the previous history.

Metastatic Carcinoma of the lungs, in my experience, has most frequently followed carcinoma of the breast. However, it must be admitted that I have had very much more opportunity of studying this group of cases than those belonging to malignant disease in any other part of the body. I have studied the chests in 225 cases of malignant disease of the breast. At present I make a chest examination of every patient referred to me for roentgentherapy for carcinoma of the breast, whether for the primary disease, ante-operative or postoperative treatment. There have been long intervals in the past when I did not follow this procedure. My experience now convinces me that this should always be done. Metastatic carcinoma of the lung is of four types:

1. *The Nodular Type*, which we have all recognized for many years, and which is characteristic as early as the nodules can be demonstrated. These nodules are generally distributed in the parenchyma of the lungs, though they may be located about the roots as well as in the parenchyma. These nodular lesions vary in size from that of a pinhead to an English walnut. They are generally not very dense or sharply outlined, but present a fuzzy appearance suggesting cotton balls. At times they are very dense and sharply defined. They are very much less dense and less sharply defined than metastatic sarcoma, though their distribution is very similar. This is the type that has been particularly studied and described by Moore and Carman. Apparently no other type was recognized by them at the time of the complete and able presentation of this subject before this Society in September, 1915. They describe the lesions as varying in size from the head of a small hat pin to that of an orange, and varying in density from a faint shading to a degree approximately that of the heart, depending on the stage of the disease. At the time of the presentation of this paper it was undoubtedly the most complete roentgenological study of this disease which had been made, and in general represents our knowledge of the subject up to that date. They had made a study of 71 cases. The character of the distribution of these lesions would lead one to suspect, as Moore and Carman also suggest, that these metastases are embolic and travel through the blood rather than through the lymph streams.

2. *The Infiltration Type* beginning at the hilus or mediastinum. This I believe is the most common and, as has been so well said by Holmes and Ruggles, is "unrecognizable in the early stages and unmistakable in the later ones." This begins as a general thickening or infiltration about the hilus which, in its earliest stages, resembles the inflammatory thickenings that we so commonly find in this region, but which I believe differs slightly in that it presents more localized density without outline at the very roots of the lungs. It then shades so gradually as it extends outward that it is lost in outline. I think I notice too a greater tendency toward an extension upward about the upper bronchial tree and toward the upper lobe than is usually found in the inflammatory lesions for, as we know, in the chronic inflammatory lesions giving rise to thickening about the hilus of the lungs, there is a tendency towards increased thickening about the lower bronchial trees as compared with the upper. Such evidence, however, in this early stage is only suggestive, and is not characteristic. As the disease progresses this area of density increases, extending toward the periphery, but extending particularly toward the upper lobe. Associated with this there is a general increase in the width and density of the mediastinal tissues. In some cases such mediastinal thickening is greatest in the upper portion just below the inner extremities of the clavicles, and at times distinct masses can be recognized in this upper mediastinum. It would seem, from

the location and general distribution and development of the disease in these cases, that it is a direct extension through the lymphatic system, just as it commonly extends through the palpable glandular system into the axilla, then into the supraclavicular region, and then into the mediastinum. Handley concludes that the vast majority of metastases are due to lymphatic permeation. It has seemed to me that in some cases I have been able to transform these lesions into dense fibrous tissue, and in a few cases the patients are still living after several years. One patient is living nine years after removal of both breasts for malignant disease, and eight years after definite mediastinal involvement. She has been treated by roentgentherapy and looks well.

3. *The Miliary Infiltration Type* (very similar to miliary tuberculosis), consisting of a fine mottling throughout the lung fields; but, as recognized also by Holmes and Ruggles, these small areas of increased density are a little larger, more dense and more sharply outlined than those of tuberculosis. This type is more difficult to diagnose, I believe, than any of the others, and it is likely that the diagnosis could not be made excepting in association with the history and careful study of the clinical symptoms. The absence of fever and the absence of other symptoms of miliary tuberculosis will easily eliminate tuberculosis in the differential diagnosis. An infiltrating syphilitic lesion of the lungs may resemble it, but can be differentiated by means of a negative Wassermann test. Infiltration of the lungs associated with leukemia also resembles this form of metastatic carcinoma, but a careful differential blood examination will eliminate the diagnosis of leukemia.

4. The fourth consists in a *progressive thickening of the pleura* associated with pleural effusion. This type is probably a direct extension of the disease from the breast into the pleura. Deaver and McFarland say that in "advanced cases the intercostal muscles often become diseased, and in some instances the pleura is involved as a result of the extension of the cancer cells through one or other of the intercostal spaces." Handley found secondary nodules on the pleura in 39 per cent of 422 cases.

It would seem from the above types that all the various theories as to the nature of the extension of metastatic carcinoma are clearly illustrated, and that all the theories are correct in certain cases.

The conclusions drawn in this paper are based upon a study of 242 cases of carcinoma in which we found positive evidence of pulmonary carcinoma in 216, negative 29, doubtful 7. This high percentage of positive findings is partially influenced by the fact that, in many instances, the examinations were made because disease was actually suspected in the chest, but it also indicates the advanced stages of the disease in which the majority of patients are referred for roentgentherapy. Of the 216 cases of carcinoma of the lungs there were

Primary carcinoma	2
Metastatic carcinoma	196
Primary sarcoma	7
Metastatic sarcoma	11

Of the cases of metastatic carcinoma of the lungs the great majority were secondary to carcinoma of the breast. I am not specifying the number because it would give a wrong impression, since all patients suffering from carcinoma have not been examined. Of the cases of metastatic carcinoma of the lungs there were

Mediastinal and hilus involvement	150
Nodular	34
Miliary	10
Pleural	12

It is evident, therefore, that the mediastinal and hilus cases are almost five times as frequent as the nodular.

The statement has been made that fat patients are more liable to early and rapid metastasis than thin patients. I therefore studied the various groups as above arranged, with the idea of determining

whether any of these groups were especially liable because of the amount of adipose tissue, also to confirm or deny, if possible, the above statement as to the relation of fat and metastasis. Of the mediastinal and hilus variety there were: fat patients, 53; medium, 65; thin, 32. Nodular variety: fat, 5; medium, 17; thin, 12. Miliary: fat, 6; medium, 4; thin, none. Pleural: fat, 4; medium, 5; thin, 3.

It would seem, therefore, (1) that thin patients are slightly more liable to the nodular variety of metastatic carcinoma, and (2) that fat and medium patients are very much more liable to metastases than the thin.

The effect of roentgentherapy on these pulmonary lesions is difficult of determination. One does not generally have the opportunity of studying these patients over a long period of time unless they are under some form of treatment. Therefore, we do not have the opportunity of comparing the progressive changes in a group of untreated cases with the changes that I can recognize in the patients who have been treated. In some of these patients treated some of the lesions seemed to have disappeared temporarily. In others, the lesions became more dense and more fibrous, resembling somewhat a fibroid phthisis. In a few instances the patients are still living several years after beginning treatment, and are apparently in good health. In most cases, however, while there is temporary improvement extending over a period of months or a year, the disease takes on a more rapid form of development with evidence of general carcinomatosis followed by death. The symptoms and roentgen findings which develop as a result of progression of the disease, most frequently involve the spinal bones, but also frequently involve the upper extremities of the humeri and the upper extremities of the femurs. The liver, in the cases I have had under treatment, has not become involved, as indicated by symptoms or enlargement, as frequently as one would suspect from the textbook statements.

In general, I believe that when the lungs are involved it must be looked upon as part of a general carcinomatosis, and with few if any exceptions one cannot expect a complete and permanent recovery.

CONCLUSIONS

1. Primary malignant disease of the lung is rare, but presents rather characteristic appearances roentgenographically.

2. Metastatic malignant disease of the lung is common, and should always be looked for in connection with advanced malignant disease.

3. A roentgen examination of the chest should be made in every case of carcinoma of the breast referred for operation or roentgenotherapy.

4. Metastatic carcinoma of the lungs may be one of four types; nodular, mediastinal with infiltration about the roots, general miliary infiltration, or pleuritic.

5. Greater attention to details in these studies will lead to earlier recognition of the disease.

BIBLIOGRAPHY

ADLER, ISAAC. "Primary Malignant Growths of the Lungs and Bronchi." Longmans, 1912.

DEAVER AND MCFARLAND. "The Breast, its Anomalies, its Diseases and their Treatment." P. Blakiston's Son & Co., Philadelphia, 1917.

HANDLEY. "Cancer of the Breast and its Operative Treatment." John Murray, London, 1906.

HOLMES AND RUGGLES. "Roentgen Interpretation." Lea & Febiger, Philadelphia and New York, 1919.

HOLT, OLIVER P. "Multiple Metastatic Sarcomas, with Report of a Case." *J. Am. M. Assn.*, 1916, LXVI, p. 171.

JACKSON, H. "Multiple Metastatic Sarcomas of the Lungs." *J. Am. M. Assn.*, 1916, LXVI, p. 833.

KEILTY, ROBERT A. "Primary Endothelioma of the Pleura." *Am. J. M. Sc.*, June, 1917, p. 180.

MOORE AND CARMAN. "Radiographic Diagnosis of Metastatic Pulmonary Malignancy." *Am. J. Roentgenology*, 1916, Vol. III, p. 126.

SCOTT, E. AND FORMAN, J. "Primary Carcinoma of the Lungs." *Med. Rec., N. Y.*, 1916, XC, p. 452.

DISCUSSION

DR. PFAHLER.—I have studied 242 cases of malignant diseases, making chest examinations, and have found malignant disease in 216. This high percentage is accounted for by the fact that I did not examine all cases of malignancy that came under my attention, but only examined cases that presented some pulmonary symptoms. Therefore this percentage value means nothing. Of this series of 216 cases, or

among them, I have found different types of malignant disease, first the nodular type which was so ably described by Dr. Moore and Dr. Carman before this Society, and which excellent paper represented approximately what we knew about this subject up to that time. I can add little to their description and very little to their conclusions. I believe, however, that my experience would indicate that the mediastinal or hilus type of development of carcinoma is much more frequent, and of these 216 cases in which I found carcinoma, 150 were of the mediastinal or hilus type, while 34 were of the nodular type. Therefore you can see, from my experience at least, that there were nearly five times as many of the mediastinal type as of the nodular; but if one studies the natural progression of metastatic disease which I think pathologists recognize as being chiefly through the lymphatic system, we may expect this mediastinal or hilus development to be far in excess of the nodular. I think that the nodular type are most likely distributed as emboli and that the mediastinal are developed through the lymphatic system. The pleural group may be extended directly through the pleura; on the other hand, they may be an extension from the mediastinum to the pleura. The miliary or general infiltrating type is the least frequent, but is one that must be recognized. Briefly, any two or three of these varieties may be grouped together. In other words, you may find the lesions belonging to all three or any two in one case.

Dr. Charles A. Waters.—Dr. Pfahler has shown one very interesting case; about the fourth or fifth slide, he gave what he called sarcoma of the testicle with metastases in the lung, the lungs showing large, well-defined, consolidated areas, lobulated in shape. Last winter, at Fort Oglethorpe, we had a case of a young man whose testicle had been removed for what was supposed to be sarcoma. There was no recurrence at site of the original tumor, but six months later his lungs were filled up with large, lobulated, well defined, solid masses, identical with the slide shown by Dr. Pfahler. Since then I have seen two similar cases, both supposedly sarcoma of the testicle with metastases in the lungs. These tumors are probably chorioepithelioma and very malignant. I will refer you to an article by Dr. J. V. Cooke, of Philadelphia, who has published an excellent account of this tumor in the Johns Hopkins Hospital Bulletin of 1914, in which he reports the necropsy of a case occurring at the Pennsylvania Hospital.

Dr. Alexander B. Moore.—I wish to call attention to the study of the subject which Dr. Carman and I made several years ago. We confined ourselves to the pulmonary lesions, and we did not include the condition of the mediastinum. Since we believed that we could not draw any conclusions from such study, Dr. Pfahler's points with regard to the mediastinum are suggestive of a good field for observation.

At the time of the study we had not seen a case of the miliary type of metastasis. Recently, however, I have had one case of a patient with infiltration at the base of the upper right lobe which seemed characteristic of tuberculosis. The patient died three weeks after examination, and at necropsy a diffuse infiltration of the right lobe was found fairly well circumscribed in its extent, and malignant in character. This brings up the point that in cases in which metastasis appears as miliary deposits and later becomes confluent, a malignant and inflammatory process cannot always be differentiated in the early stages.

I would like to ask Dr. Pfahler if he is able to differentiate a simple and malignant fibrosis; personally I have been perplexed by these conditions especially in senile patients.

Dr. G. E. Pfahler.—I know pathologists have had a great deal of discussion about these testicle tumors. I think they settle down to the chorioepithelioma as the diagnosis. But some are diagnosed as chorioepithelioma and some as sarcoma. It makes very little difference to us except as to how we should classify the metastases.

The liver has in my study, as far as I could recognize by enlargement or by symptoms, been only comparatively rarely involved. The bone has been involved in about ten per cent; but we do not examine all the bones in these cases. Probably they are involved in a larger proportion of cases.

In regard to paralysis of the vocal cords, I have made no statistical record, but I remember there are only two or three cases in which there was involvement due to mediastinal pressure. Generally this infiltrating type does not do it. In one case that came to me, I was able to recognize a small nodule which pressed on the recurrent laryngeal nerve.

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CHRONIC OBSTRUCTIVE LESIONS OF THE DUODENUM

Attention has been called to chronic obstructive lesions of the duodenum from time to time by articles in the various medical journals. Recently Vanderhoof,[1] Bloodgood[2] and Kellogg[3] have discussed the clinical and surgical aspects, while Jordan,[4] Engelbach[5] and Quimby[6] have described the *x*-ray method of examination and the findings. The etiology has been described by Kellogg as follows:

"At the operating table we have learned that the obstruction may involve the first portion of the duodenum only, the first and second portions, or the entire duodenum.

"When the first portion only is dilated the junction of the first and second portions is angulated, caused by the duodenum being drawn up close to the liver by contraction of mesenteric bands or by adhesions binding together the first and second portions, or by gastroptosis, the duodenum remaining fixed. In the second group giving dilatation of the first and second portions it has appeared to be the result of adhesions extending from the gallbladder or hepatic flexure of the colon.

"In obstruction of the entire duodenum I have frequently found the condition described by Bloodgood, *i.e.*, a redundant cecum displaced into the pelvis with a short mesentery at portion of ileum near the cecum. In this group I believe the significant factor has been the dropping of the hepatic flexure which causes a straight pull of the distended bowel from the splenic flexure across the point of union of the duodenum with jejunum. The condition may exist without prolapse of the cecum, and the following causes are suggested:

"Duodenojejunal kink from prolapsed cecum and hepatic flexure; prolapse of transverse colon; adhesions from cholecystitis; ulcer; inflammation at duodenojejunal junction; constriction of opening in mesentery through which the duodenum passes; faulty development of the lower thoracic region; gastroptosis with stretching of the attachment of the second portion of duodenum; disease of pancreas.

"It is certain that frequently a con-

[1] Douglas Vanderhoof. *J. Am. M. Assn.*, Aug. 18, 1917.
[2] Bloodgood. *J. Am. M. Assn.*, 7, 13, 1912.
[3] Kellogg. *Surg., Gynec. & Obst.*, Feb., 1919.
[4] Jordan. *Brit. Med. Journal.*
[5] Engelbach. *Journal of Roent.* Volume 1. No. 1.
[6] Quimby. *Am. Jour. Electrotherap. & Radiol.*, Jan., 1919.

siderable degree of obstruction exists without symptoms, the condition being found at operation or by *x*-ray examination."

The clinical picture as drawn by Vanderhoof is as follows:

"(1) Persistent or recurring vomiting. In most instances the vomitus contains bile, often in a considerable quantity.

"(2) Pain in the upper part of the abdomen, generally referred to the right hypochondrium. As a rule, this is described as an aching or dragging pain, but it may be severe, so as to suggest biliary colic, or in other instances, it simulates the pain of peptic ulcer with irregular food relief. (It frequently closely imitates appendicitis or renal colic.)

"(3) 'Habitus enteroptoticus' often associated with exaggerated lordosis.

"(4) Obstinate constipation is the rule, although this may not be a feature of the case. Occasionally the stools are colorless and relatively free from bile.

"(5) Vague toxic symptoms, headaches, neuralgia, etc."

The most important of the roentgenological findings are:

1. Marked retention in the duodenum for which no other cause can be given. This is commonly known as puddling.
2. Writhing and twisting of the duodenum.
3. Reversed peristalsis.
4. Tenderness over the angle of Trietz.
5. Dilatation of the duodenum.

The first four of these signs may be found in the course of the ordinary gastric examination, and while the fifth may be so observed, a special technique is usually required which is described by Engelbach as follows:

"With the patient before the vertical fluoroscope, after the aqueous solution of barium is given, and before the second buttermilk meal of barium is taken, the terminal portion of the duodenum the location of which has been determined by watching the barium pass through it, is constricted by pressure of the left hand against it and the body of the vertebra. The remainder of the duodenum is then filled with barium by grasping with the right hand the antrum and pyloric end of the stomach and milking its contents into the duodenum."

The appearance of the dilated duodenum is rather striking in that it is so very large in comparison to the normal, and the markings of the valvulæ canniventes are conspicuously absent or nearly so.

Just why this condition has not received the attention its seriousness merits by *x*-ray workers is difficult to explain. Perhaps the rather limited use of the fluoroscopic screen may account for it.

The fact remains that many of our patients have been labeled neurasthenics or indeterminates by our incomplete examinations, whereas the method offers a diagnosis in most if not all of these lesions.

NOTICE OF MEETING

The Middle Section of the American Roentgen Ray Society will hold its meeting at the Congress Hotel in Chicago on Saturday, February 21. The forenoon will be occupied by speakers from Chicago. The afternoon program will consist of papers by those attending, and in the evening there will be an informal demonstration of lantern slides from interesting cases. A dinner will be served between the afternoon and evening sessions. All those who can offer papers or demonstrate slides will communicate with Dr. A. F. Tyler, 507 City National Bank Building, Omaha, Nebraska.

TRANSLATIONS & ABSTRACTS

ZENO, L. O. Chronic Intestinal Stasis. (*Rev. méd. del Rosario*, May, 1919, Vol. 9, No. 2, p. 118. Ref. *J. Am. M. Assn.*, July 19, 1919, p. 236.)

Zeno has been working with Lane in England and describes with numerous illustrations Lane's theories in regard to chronic intestinal stasis and its causes. He criticizes Lane's ideas, and presents arguments to the effect that the avascular bands are found in the majority of persons, and have no pathologic significance. The same is true of the vascular membrane, Jackson's membrane. This represents relics of the direct prolongation of the great omentum in fetal existence. In studying these bands and membranes we must not be misled by the multiplicity of names that have been conferred on them. The surgeon in particular should familiarize himself with the various aspects which these normal formations may assume. Zeno found the so-called duodenojejunal band in 60 per cent of forty child cadavers, the ages ranging from 2 months to 10 years. He also noted that when the bismuth suspension reached the point of the angulation it seemed to slip through the kink as readily as through the wide lumen above. The bands do not always occur at points where they can by any possibility serve as supports, while they may be conspicuous by their absence at other points where they would certainly develop if Lane's theory were sound.

LUMIÈRE, A. Accessory Focal Spots for Rays Discharged by Tubes Used in Radiology. (*J. de radiol. et d'électrol.*, Par. May, 1919, Vol. 3, No. 5, p. 193. Ref. *J. Am. M. Assn.*, July 19, 1919, p. 231.)

Lumière cites those who have been making a study of the accessory sources of the roentgen rays, and then describes similar research undertaken with the tubes as usually employed in radiology and also with all the sources of the principal or parasite rays discharged by the apparatus producing the roentgen rays. Some of the radiograms were taken with the tube turned completely around, the exposure made through the thin plate of the anticathode, directly opposite to the usual direction of the rays. The roentgenogram was as perfect (with the Muller tube) as when the routine conditions had been exceptionally favorable.

GUILLEMINOT, H. Comparative Tests of Roentgen Tubes. (*J. de radiol. et d'électrol.*, Par. May, 1919, Vol. III, No. 5, p. 193. Ref. *J. Am. M. Assn.*, July 19, 1919, p. 295.)

Guilleminot describes how to compare the sharpness of the images, the total output of rays per current, and the endurance of the tubes. The fluorometer is the main reliance in the tests.

ORTIZ, RUBEN VILA. Serotherapy. (*Rev. méd. del Rosario*, May, 1919, Vol. IX, No. 2, p. 118. Ref. *J. Am. M. Assn.*, July 19, 1919, p. 166.)

Ortiz protests against the custom in Argentina of dispensing antiserums in such small doses that fifty-six vials had to be used, for instance, in one case of tetanus, to give 84,000 units of antiserum. The small number of units per vial renders treatment unnecessarily expensive. He urges that ampules should be available containing 100 c.c. of the antiserum.

EIKEN, T. Roentgen Therapy of Cancer. (*Hospitalstidende*, Copenhagen, May 21, 1919, Vol. LXII, No. 21, p. 641. Ref. *J. Am. M. Assn.*, July 19, 1919, p. 236.)

Eiken reports from Rovsing's private clinic the complete cure of a woman of 46 who in the course of fifteen months had had a mammary carcinoma removed and also two recurrences at its site, and during the last six months had been having pains in the femur on that side, and a large metastatic tumor developed here. This tumor subsided completely under vigorous roentgen treatment. The pains were relieved after the first application (30 H. through 6 mm. aluminum), and by the end of the month she could take a few steps without support. The results were as complete as with excision of the focus, but this treatment, as too often happens, was not applied until the malignant

disease had invaded practically the whole body, and the patient succumbed to metastasis elsewhere. In another case a large mammary cancer subsided to a clinical cure under one exposure (50 H. 8 mm. aluminum, ninety minutes) with a second exposure after a month's interval. All his other patients succumbed sooner or later to metastases probably already installed.

SHITTENHELM, A. Roentgen Diagnosis with the Aid of Artificial Gas Accumulation in the Abdominal Cavity (Ueber Roentgendiagnostik mit Hilfe Künstlicher Gasansammlung in der Baudehöhle). (*Deutsche med. Wchnschr.*, Berl., 1919, XLV, No. 21, 566.)

Two methods are in use. 1. Contrast effects are produced by gaseous expansion of the stomach and intestines. The intestine is filled with gas by means of a rectal rubber tube and the stomach by means of a stomach tube. This method gives usually a clear picture of the position, form and size of the liver, spleen and frequently also of the gallbladder as well as of certain tumors. When the results are not satisfactory the following method is used: 2. The peritoneal cavity is filled with oxygen. The procedure is quite simple in patients with ascites, but patients without ascites present rarely any difficulty. A syringe provided with a fine cannula and filled with a physiological salt solution is cautiously forced through the abdominal covering, the finger resting on the piston of the syringe. The easy flow of the liquid shows that the needle has reached the abdominal cavity. The oxygen is introduced by means of an insufflation apparatus such as is used in pneumothorax therapy. About 2 liters of oxygen are usually sufficient. The patient is examined first lying down and then standing. On rising, the patient frequently experiences pain due to adhesions especially of the liver. By this method the liver, and especially the spleen when enlarged, are well outlined. The gallbladder, however, is not always seen.

KEPPLER, W. and ERKES, F. Roentgen Diagnosis in Diverticula of the Esophagus (Zur Roentgendiagnose der Speiseröhre). (*Med. Klin.*, Berl. & Wien, 1919, XV, No. 20, 480.)

During the past year the authors observed two cases of esophageal disease in which the roentgen plates clearly pointed to a diverticulum, but when the operation was performed it was found that the pathological process was a cancer. The authors then looked up the literature and found that in 250 cases reported the roentgen diagnosis had erred in 3.6% (including the two cases mentioned here). While this result does not lessen the value of the roentgen rays it is well to remember that in stricture processes of the esophagus of various etiology the *x*-ray may present an appearance which cannot be differentiated from a genuine diverticulum.

POLLITZER, H. Asthma-like Symptoms Due to Roentgen Rays in Leukæmia and to the Effects of Vaccines in Typhoid Fever and the Pathogenesis of These Symptoms (Ueber Asthmaartige als Roentgenwirkung bei Leukämie und als Vaccinewirkung bei Abdominal Typhen und die Pathogenese dieser Erscheinungen). (*Med. Klin.*, Berlin, 1919, XV, No. 19, 457.)

In exposing the spleen to the *x*-rays in the treatment of leukæmia sometimes a temporary bronchitis with eosinophilia and relative difficulty of breathing is noticed. Difficult breathing and marked expansion of the lungs is also observed in vaccine treatment of typhoid fever. Both syndromes seem to be due to the pathogenetic effects of vaccination with a foreign protein, in the one case of the bacteria, in the other of the dying leukocytes. The syndrome in leukæmia seems thus to form a bridge to bronchial asthma.

RAUTENBERG, E. Pneumoperitoneal Roentgen Diagnosis of the Kidneys. (*Berl. Klin. Wchnschr.*, 1919, LVI, No. 9, 201.)

The method is so simple that the author does not use special instruments. A fine cannula and double bellows are sufficient to fill the peritoneal cavity with air. The kidney is best seen when the patient lies on his side, as the convolutions of the small intestine sink down by gravity. The field of vision is limited below by the spinal column, and the kidney lies free behintl the air-filled portion of the abdominal cavity. Sometimes, however, the upper portion of the right kidney is covered by the liver, but

even then the outline of the kidney can be followed. Such a picture is of great importance, for by the usual methods the kidney can never be seen clearly and its form and size are quite indistinct. To judge of the size and changes of form of the kidney it is advisable to keep always the same focal distance (60 cm.). Displacements of the kidney are clearly shown by this method. The diagnostic procedure described forms an important aid to functional diagnosis. At the close the author discusses several practical cases of renal tumors and kidney stones.

BURCHARD, A. The Roentgenological Demonstration of the Muscle Changes Produced by the Various Anaërobes Found in Gaseous Edema (Ueber den röntgenologischen Nachweis der durch die verschiedenen, beim Gasödem gefundenen Anaërobier hervorgerufenen Muskelveränderungen). (*Fortschritte a. d. Geb. d. Röntgenstrahlen*, Hamb., 1919, XXVI, No. 3, 260–270.)

The author reports 9 cases of wounded soldiers in whom gaseous edema and gaseous gangrene developed. The roentgen examination showed that two different forms of muscle changes take place. In one form the roentgenogram shows a spotted and layer-like arrangement of the gaseous accumulations, in the other the muscle fibers are completely filled with extremely fine gas bubbles but the muscle structure is clearly distinguishable. The first form occurs only in cases of infection with the Fränkel bacillus, the second form was observed in infections with the bacillus butyricus (Aschoff) sometimes associated with the bacillus putrificus.

The roentgen diagnosis in gaseous edema is very important. The processes in the muscle which are usually only recognized at the operation or post mortem, are early shown in the roentgen plate, which thus furnishes important data as to prognosis and treatment.

STRAUSS, O. Roentgentherapy and the Problem of Cancer Treatment. (*Fortschr. a. d. Geb. d. Röntgenstrahlen*, Hamb., 1919, XXVI, No. 3, 232–244.)

Early *x*-ray treatment of cancer is of great importance, but there is no means of establishing an early diagnosis; even a fully developed cancer is sometimes difficult to diagnose. Two effects of cancer are harmful: the atypical catabolism of the albuminoids and the diminution of the oxidative processes in the body. Cancer consumes not only its own albumin but also that of the organs. The heterolytic ferment of cancer gets at a later stage into the circulation and we have the clinical picture of cachexia. The cachectic organism is much less sensitive to the *x*-ray than the non-cachectic. Carcinoma of the cervix uteri is diagnosed much earlier than any other form of cancer and this explains the favorable results of the *x*-rays in cervical carcinoma. Except in cervical cancer roentgentherapy of carcinoma is not superior to surgical treatment. The best results are obtained by a combination of both methods. Statistics show that the application of the roentgen rays in operated cancer cases has increased the permanent cures by 30 per cent. Roentgen treatment plays also an important rôle in inoperable cancer.

CLARK, JOHN G. The Treatment of Myoma Uteri with Radium. (*J. Am. M. Assn.*, Vol. LXXIII, Sept. 27, 1919, p. 957.)

As a result of observations made in over 150 cases, it may be positively stated that from the standpoint of efficiency, safety and morbidity radium must supplant surgery in the treatment of uterine myomata and intractable myopathic hemorrhage, within certain limitations. Beyond these limitations surgery is indicated in properly selected cases. When radium is not available the use of the roentgen ray may be used as a substitute, in skillful hands. Only gradually and to a limited extent has radium been used prior to the menopausal cycle. It may be as potent in bringing on a menopause as oöphorectomy. Fifty mg. in the uterus of a young woman for 24 hours will do this.

There are three essentials in treatment: accurate diagnosis, proper selection of cases and careful gradation of dosage, especially in young women. Experience has brought out certain prominent facts governing treatment: (1) The tumor must be uncomplicated by inflammatory disease, and never treated if so complicated. A flare-up of a quiescent salpingitis or other inflammatory condition is likely to be induced. (2) The growth must be

causing hemorrhage. (3) It must not be too large. The extreme limit is a five months' pregnancy, and the size of a three months' pregnancy is a much safer limit, except where there are contra-indications to operation. The larger growths are more likely to have associated lesions or may be pure fibroid, dense hyaline or calcareous types, not responsive to radiation. (4) Pain is not as a rule relieved, especially in inflammatory disease, and cases with pain lateral to the uterus are not radiated. Moreover, operation offers the opportunity to ascertain the extent of additional pathology. (5) Malignant and benign degenerations contra-indicate the use of radium. One frequently finds a degree of anemia, a cachectic appearance or a toxic asthenia not accounted for by the amount of hemorrhage. This may be due to malignant degeneration, but more often to benign degeneration, the absorption from which causes the general condition. Hysterectomy is quickly followed by a return to normal, but radium only makes matters worse by hastening the degenerative process.

The possibility of sarcoma being present need hardly be considered. Out of 816 myomas examined in the laboratory, only 26 showed sarcoma.

Symptoms accompanying radiation: Nausea is frequently observed, either at once or 24 to 48 hours after the application. The routine administration of morphin may be partly or wholly responsible for this in many instances. Pain is a variable symptom, and may be due to the routine curettage for diagnostic purposes. If persistent or accompanied by fever, an acute inflammatory attack or exacerbation of a quiescent process is to be suspected. It is proposed to avoid this risk by omitting curettage in cases with periodic menorrhagia following the menstrual type without intermenstrual spotting. This would exclude the possibility of a fundus carcinoma, but when intermenstrual spotting or continuous bleeding are present, curettage is essential. Cancer of the fundus requires hysterectomy. Leucorrhea usually follows for 3 to 6 weeks, but is not profuse. Hemorrhage usually ceases at once, but not always. The menopause is variable. In marked anemia, the change is more abrupt and with more pronounced symptoms. This may be due to the sudden check in the activity of the hematogenous system due to the stoppage of bleeding. Patients as a rule do not object to the artificial menopause so produced.

Technic: Under gas anesthesia, the cervix is dilated and a simple curettage is performed for diagnostic purposes. This is followed by light packing of the uterine cavity with 5 per cent solution of iodin momentarily before the radium is introduced. Fifty mg. radium in a platinum or silver capsule enclosed in a black rubber tube tied at both ends is then introduced into the fundal cavity to the top. If the cavity is three and one half inches or more in depth, two tubes of 25 mg. each, are used tandem. In women in the menopausal years, this is allowed to remain 24 hours. Under the age of 40, the dose is graded according to years. If 35 to 40, the application lasts 12 hours, and if younger, 6 hours, making a reapplication if necessary. In this way the menopause is likely to be avoided. After withdrawal of the radium, the patient is kept in bed three days, and discharged at the end of five days, and permitted to resume her usual duties. As a rule the menopause is permanent when induced, but periods may return.

Results: In six cases failure of satisfactory relief required subsequent hysterectomy.

H. K. Pancoast.

Bumpus, H. C. Diverticula of the Posterior Urethra. (*Surg., Gynec. and Obst.*, October, 1919, Vol. XXIX, No. 4.)

The repeated finding of diverticula of the posterior urethra during routine cystoscopic examination led to a search through the records of the section of Urology of the Mayo Clinic. The literature as reviewed by Ehrlich revealed but 70 cases of urethral diverticula up to 1908. Watts reported one case and reviewed the literature in 1906 and Englander added two cases in 1917. In the cases at the Mayo Clinic the diverticula were all confined to the posterior urethra; their clinical histories vary considerably from those reported in the literature.

Watts, besides his complete and thorough review of the literature, gave an excellent classification of urethral diverticula, as follows.

A. Congenital diverticula

B. Acquired diverticula

1. From dilatation of urethra resulting from

a. Calculus
b. Stricture

2. With perforation of the urethra resulting from
a. Injuries to the urethra
b. Rupture of abscess into the urethra
c. Rupture of cysts into the urethra.

A differentiation is also made between true and false diverticula. The former is a dilatation of the normal urethra with a mucous membrane lining identical with that part of the urethra from which it arises. The latter is the result of urethral rupture and, therefore, has a lining of epithelium or fibrous tissue according to the extent of repair that has occurred. Of the true diverticula the congenital offers the most perfect type. It occurs in the anterior urethra and is probably the result of a failure of the urethral floor to close during fetal life, a condition similar to that of hypospadias, or, as Watts suggests, a condition due to congenital stricture or phimosis.

Diverticula of the posterior urethra are probably always of the acquired type and usually of a traumatic origin. Surgical procedures about the perineum either for the drainage of the seminal vesicles or for the removal of bladder or prostatic stones, are probably the most frequent factors in their formation. Frequently falling astride some hard object with resulting rupture of the urethra, or the formation of a hematoma with secondary rupture into the urethra, results in their formation. Strictures are also an etiologic factor, both because of their tendency to cause dilatation posteriorly and because of the inaccurate passage of sounds in an attempt to dilate with resulting false passage and urethral rupture. Abscess formations in the neighborhood of the posterior urethra or in the seminal vesicles, with secondary rupture and drainage into the urethra are frequently the origin of diverticula.

In cases in the literature a tumor at some point along the urethra is an almost constant finding, and the history of being able, by digital pressure, to expel varying amounts of urine from such a mass is considered very suggestive. Diverticula may develop and yet give no physical signs; they even burrow under the bladder until they nearly equal it in size and capacity. Lane reported several cases similar in character, found at necropsy.

Diverticula of the posterior urethra give a series of symptoms:

1. Dribbling or complete incontinence, depending on how near the diverticula is to the external sphincter.

2. Dysuria resulting from the passage of urine through a constantly inflamed and irritated posterior urethra; this is often accompanied by tenesmus.

3. The presence in the perineum of a pocket filled with infected residual urine causing a constant feeling of discomfort often described as "resembling a ball of fire" which compels frequent urination in an effort to relieve the condition.

That such diverticula may be overlooked is easily understood if it is realized that the condition is often associated with a normal bladder.

CONCLUSIONS

1. Diverticula of the posterior urethra are generally of the acquired type.

2. Probably the most frequent etiological factor is a previous perineal operation.

3. They give rise to a definite syndrome, namely, incontinence, dysuria, interrupted micturition, perineal pain, and pyuria.

4. The absence of perineal tumor is not incompatible with their presence.

5. Since they may be associated with a normal bladder they may easily be overlooked unless the posterior urethra is carefully examined.

W. W. BELDEN.

CLARK, S. M. D. Use of Radium in Fifty Cases of Uterine Hemorrhage from other Causes than Carcinoma or Myomas. (*J. Am. M. Assn.*, Vol. LXXIII, p. 952, September 27, 1919.)

The cases are divided into three groups:

1. Young women with excessive bleeding without marked discomfort but with constitutional impairment from loss of blood, with or without any anatomical defects. In such cases the usual measures fail and radical operation is the only procedure left, except radium. As radium acts by altering the endometrium and myometrium rather than by alteration of ovarian function, it is distinctly

indicated. A satisfactory result may be obtained without complete suppression of menstruation, but if the latter is necessary it is preferable to an abdominal operation. In one case out of five, one application 750 mg. hours relieved symptoms without stopping menstruation. In four others, treatment varied from 1275 mg. hours, two applications, to 3859 mg. hours, four applications, in all of which there was complete cessation of menstruation.

2. Aggravated and intractable cases of dysmenorrhea which have resisted all treatment, and with general health impaired. Usually neurotic type, advancing in years and unmarried. Patients have about ten comfortable days in a month. There may or may not be anatomic wrong. Menstruation must be stopped. Radium will produce the desired effect with less pain and discomfort than an operation and is not followed by as intense nerve disturbances. In one case out of twelve radium relieved pain and normal menstruation followed, while in the other eleven complete relief followed chiefly through suppression. In the one case one application was given of 50 mg., 525 mg. hours. In the other cases two to six applications were made, usually with 50 or 75 mg., and the total exposures varied from 1250 to 3000 mg. hours.

3. The greatest number of cases are those coming under the classification of "chronic endometritis." The exact pathological condition may be polypoid, hypertrophic or hyperplastic endometritis, or result from myopathic or vascular changes. Patients are usually between the ages of 36 to 56 years, many have borne children, the uterus usually is in malposition, is enlarged and firmer than normal, and there is an associated cervicitis. All other methods of treatment aside from hysterectomy and radium have failed. Inflammatory disease and malignancy must first be excluded. It is the rule in radium treatment that menstruation must be suppressed, but the nerve disturbance is less than with operation, and there is less discomfort and less danger to life. Such uteri have completed their functional periods. Thirty-five cases of this kind are reported, with one partial failure. On account of continued bleeding, hysterectomy was performed because of the potential danger of malignancy. In this case three applications of radium were made, using 50 to 100 mg., and the total dosage was 2250 mg. hours. In the others, the shortest treatment was one application 50 mg. for ten hours. Several others were nearly as short. Others required from two to four or even six applications, with usually 50 to 75 mg. of radium, and the dosage varied from 1000 to a maximum of 3450 mg. hours.

H. K. Pancoast.